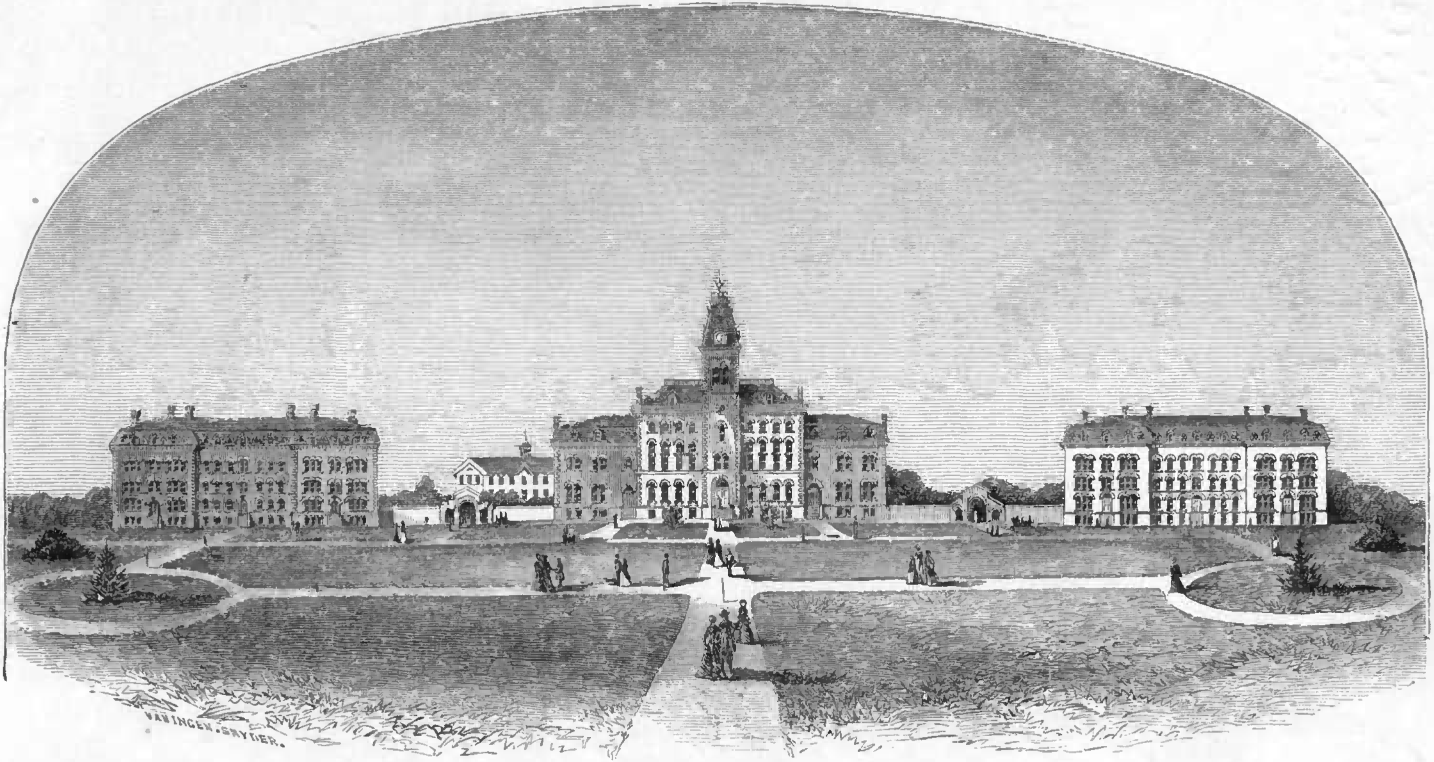
PLATE I.



CORNELL UNIVERSITY.

REPORT

OF THE

COMMISSIONER OF AGRICULTURE

FOR

THE YEAR 1869.

WASHINGTON.
GOVERNMENT PRINTING OFFICE.
1870.

JOINT RESOLUTION FOR PRINTING.—JULY 14, 1870.

Resolved by the House of Representatives, (the Senate concurring,) That there be printed of the Annual Report of the Commissioner of Agriculture for 1869, two hundred and twenty-five thousand extra copies; one hundred and eighty thousand of which shall be for the use of the House, twenty thousand for the use of the Senate, and twenty-five thousand for distribution by the Commissioner of Agriculture.

CONTENTS

Page.
Report of the Commissioner, Horace Capron........ 5
Report of the Statistician, J. R. Dodge........ 20
Report of the Entomologist, Townend Glover........ 60
Report of the Chemist, Thomas Antisell........ 65
Report of the Superintendent of Gardens and Grounds, William Saunders........ 79
Report of the Botanist, C. C. Parry........ 91
Report on Agricultural Meteorology, André Poëy........ 97
Report of the Editor, J. R. Dodge........ 157
Including papers as follows:
Landscape gardening........ 159
Apples for the Southern States........ 184
Remarks on pear culture........ 198
The cranberry interest........ 204
The onion........ 213
American sumac........ 230
Culture of the opium poppy in Smyrna........ 233
Tea culture in the United States........ 235
Tests of department seeds........ 242
Exchanges with foreign societies........ 256
The Jenequen or Sisal hemp........ 257
Recent farm experiments........ 267
Recent progress in steam culture........ 296
The American steam plow........ 305
Agricultural patents of the year........ 315
Progress of the beet-sugar manufacture in Europe........ 334
American dairying........ 352
Madison County cattle sales........ 371
A few facts in sheep husbandry........ 378
Trichina spiralis........ 389
Laws relating to fences and live stock........ 394
Vineland as a lesson in colonization........ 410
The American Institute Farmers' Club........ 416
Agricultural facts of the year........ 428
Progress of industrial education........ 452
The books of the year........ 487
State reports on agriculture........ 516
Mineral fertilizers of the Mississippi Valley........ 548
Facts concerning Oregon........ 584
Agricultural capabilities of the Territories........ 601
Donations to the agricultural museum........ 636
Meteorology of 1869........ 638
Index to the report for 1869........ 689

ILLUSTRATIONS.

		Page.
1.	Cornell University	Frontispiece.
2.	Vitis labrusca; variety, Concord	81
3.	Vitis æstivalis; variety, Devereux	84
4.	Vitis cordifolia; variety, Clinton	85
5.	Vitis vulpina; variety, Scuppernong	86
6.	Hunge (apple)	186
7.	Buckingham (apple)	186
8.	Boran's Winter (apple)	187
9.	Broadnax (apple)	187
10.	Hall (apple)	189
11.	Edwards (apple)	189
12.	Faust (apple)	191
13.	Golden Wilding (apple)	191
14.	Clarke's Pearmain (apple)	192
15.	Matimuskeet (apple)	192
16.	Nickajack (apple)	197
17.	Green Cheese (apple)	197
18.	Lawrence Pear Tree	198
19.	Herstine (raspberry)	204
20.	Saunders (raspberry)	204
21.	Sumac Mill	230
22.	Sumac Mill	232
23.	The Sacchi (Sisal hemp)	258
24.	The Cajun (Sisal hemp)	259
25.	Steam Cultivator	296
26.	Steam Harrow	301
27.	S. B. Wilkins's Steam Plow	315
28.	J. H. Northcott's Steam Plow, and Lewis Stewart's Steam Plow	316
29.	A. J. Stevens's Steam Cultivator	317
30.	Joseph G. Knapp's Steam Plow	317
31.	Townley & Friedrich's Steam Plow	318
32.	A. L. Taveau's Steam Plow	318
33.	A. L. Taveau's Revolving Harrow	321
34.	Butter-making Utensils	367
35.	Cotswold Ram	381
36.	Acarus of Sheep Scab	386
37.	Trichina Spiralis	389
38.	Institute of Technology, Boston, Massachusetts	478
39.	Institute of Technology, Boston, first floor	485
40.	Institute of Technology, Boston, second floor	486
41.	Institute of Technology, Boston, third floor	487
42.	Geological Map of the Southwestern States	548
43.	Geological Map of the Western Central States	564
44.	Geological Map of the Northwestern States	578
45.	Isothermal Lines of Alaska	638

REPORT

OF THE

COMMISSIONER OF AGRICULTURE.

DEPARTMENT OF AGRICULTURE,
Washington, D. C., December 1, 1869.

SIR: I have the honor to submit the eighth annual report of the Commissioner of Agriculture.

The year has been one of vicissitude; of mingled constancy and change; of general fruitfulness and local blight; of genial sun and fructifying rains, with periods of drought and inflictions of destroying tempest and deluging flood. The meteorology of the year has been marked and peculiar, threatening disasters which have been partially averted, and attended with various compensations. He that "causeth the grass to grow for the cattle and herb for the service of man" has overruled the strife of the elements and crowned another year with goodness and blessing, so that "the pastures are clothed with flocks, and the valleys are covered over with corn."

The effect of these meteorological changes has been more or less injurious in proportion to the degree of negligence in culture and crudity in condition of heavy or moist lands. In some instances soils which are naturally of superior excellence, but in inferior mechanical condition, have yielded unprofitable returns. The production of the country might be increased hundreds of millions of dollars by more thorough comminution of soils, by their proper modification and amelioration, and by the draining of saturated or tenacious lands. The loss from want of these agricultural improvements, serious in any season, is exceptionally large the present year. As another result, a wider range is seen in the rate of production per acre, extending from decided success to utter failure.

The monetary returns of the harvest have been equally varied with the degree of natural production. The general financial tendency toward a shrinking of values has reduced the prices of abundant crops, and caused a depression which has not been exceeded in the same quarters for years. The wheat farmer, with a full garner, is not joyous over his market returns; while the corn-grower, if blest with a full crop, has no cause for despondency. The cotton producer, who has not yet glutted the markets of the world with over-production, is jubilant over his golden gains. This difference in values and resulting

profits, always varying, yet ever observed in some degree, is more strikingly prominent than usual, and teaches the necessity of accurate calculation of the changing proportions of supply and demand, and the importance of variety in farm production, with due regard to a careful equilibrium between the multiform branches of rural industry.

The tendency of present prices of farm products indicates the necessity of increased attention to the propagation, growing, and fattening of farm animals, and to the production of meats, poultry, butter, cheese, milk, and various other animal products; while the prevalence of special cropping, upon a depletive and exhaustive system, enforces urgently the appeal for a mixed husbandry based upon stock-growing.

The activity and business energy of our countrymen naturally lead to great enterprises, in which much capital is employed, and labor is economized and made effective by means of machinery. While a mixed agriculture is recommended for farmers of limited means and moderate ambition, large ventures in special culture, by men of ample capital and great executive ability, should not be discouraged, unless their increased production is obtained at the expense of deterioration of the soil. Examples of large products and great profits act as a spur to the enterprise of the average farmer, but may work a serious injury to those in whom energy and zeal are not sufficiently supported by capital and ability to manage large affairs.

MENTAL CULTURE.

The American farmer is cultivating not soil alone, but brains. The most potent agricultural educator is the agricultural press. It wields a power a tithe of which it did not possess twenty years ago. Its improvement within that period has been wonderful, and its progress was never so apparent as at the present time. The most practical, earnest, and scientific workers in agriculture are the editors and writers of our rural literature. The mass of farmers are advancing in intelligence, and no longer stigmatize as "book farming" the written experience of the most scientific and the most successful of their own class.

The industrial colleges, from which co-operation in this direction is confidently expected, are yet in process of organization. The Cornell University, with a munificent endowment, has been opened under gratifying auspices; a new faculty has been assigned to the Pennsylvania College; the New Hampshire College of Agriculture and the Mechanic Arts has just finished its initiatory course; the Massachusetts Agricultural College is fully organized and working successfully; the State Agricultural College of Michigan has enjoyed a year of prosperity; and the institutions of Maine, Connecticut, Maryland, Kentucky, Illinois, Wisconsin, Iowa, and Kansas have reported a reasonable degree of progress. Other institutions are on the eve of organization for active effort. It is desirable that all the States shall employ in the wisest manner this agency for advancing the intellectual status of the industrial classes.

RENEWAL OF CANADIAN RECIPROCITY.

The farming interest is unalterably opposed to the proposition for the renewal of the reciprocity treaty with the Dominion of Canada, a measure fraught with dangerous competition, with few compensating advantages; a measure by which surplus crops grown with cheaper labor, bearing no part of the burden of our national taxation, would find convenient market in our seaboard cities, while our own surplus, produced at greater distance from our principal markets, is subject to expensive transportation and heavy taxation. A limited number of merchants and forwarders in northeastern cities might realize a small advantage, but no class of American farmers would derive the least benefit from the arrangement. There is no good reason why the duties levied upon imports should not be operative alike, without favor or invidious distinction, upon all foreign powers and nationalities. If Canada, on one side, may be exempt from commercial restrictions, Mexico, on the other, may claim a similar advantage, and any foreign nation may demand exemption from restrictions which are equivalent only to the excise burdens placed necessarily upon our own people.

THE WOOL INDUSTRY.

A period of depression has been realized by our wool-growers during the past four years, which has been shared by all other wool-growing countries, but which has been greatly modified and relieved by the operation of the present tariff, which has prevented the utter prostration of this necessary branch of industry in the present, and assured its rapid recuperation in the future. A sufficient quantity of carpet wools, not produced in this country, has been admitted from abroad at low rates of duty; a sufficiency of most grades of clothing wools has been produced at home and sold at lower prices than when foreign wools were admitted at nominal rates; and an impetus has been given to the production of combing wools, which will not only greatly benefit the textile interest, but improve the quality and quantity of mutton in the markets of the land.

Dissatisfied with present receipts and gloomy over future prospects, many farmers have sacrificed a portion of their flocks during the past year. It is estimated that four millions of culls were killed for pelts and tallow. American agriculture, in all its branches, is peculiarly subject to periods of elevation and depression from the impulsive action which stimulates over-production at one time, followed by panic and abandonment of the temporarily unprofitable pursuit. The wool interest has often suffered, not merely from ordinary causes of fluctuation, but more disastrously still from tariff changes, frequent and extreme as well as unexpected. It is essential to the welfare of this important industry that the present moderate schedule of duties should be continued without modification.

THE CENSUS OF 1870.

The importance of full and accurate statistics of production has never been sufficiently realized. In no country within the pale of civilization is the necessity of such means of information so imperative. Until 1850 no schedules of agricultural production were incorporated into the decennial census, and then only a few of the leading features were included. In 1860 the list was enlarged, while the anomalous omission of *acreage* of crops still marred the value of the work. This feature, the first in the economy of every foreign census of production, furnishes, in connection with that of quantities, invaluable means of comparison and analysis. The enlightened judgment of Congress will doubtless remedy this defect in former enumerations in legislating for the census of 1870; and it is of equal importance that the vague and meaningless distinctions of "improved" and "unimproved" land should be replaced by more natural and useful divisions, showing the acreage of actual tillage, of permanent pasture, fallows or commons, and wood lands. While the schedules should be judiciously enlarged, care should be exercised to prevent burdening them with excessive fullness, complexity, or obscurity, which would militate against the accuracy and diminish the value of the returns. The question of taking the census every five years by the national government is worthy of deliberate consideration in a country so rapidly progressive in population and sentiment; and it is to be hoped that the provision for annual returns of the principal farm products by local officers of certain States will be extended till it embraces all the States.

SOUTHERN AGRICULTURE.

The continued high price of cotton has made its culture more profitable than at any former period, and the crop of 1868 has yielded a larger amount of money than that of 1859. The yield of the past year exceeded very slightly the estimate of this Department, which was 2,380,000 bales. The present season has witnessed great activity in this culture, an increase of area cultivated, and more general and generous fertilization; and has also been characterized by drought in the seaboard States, and other causes of diminished production, which have modified the expectations of planters; yet the crop will exceed that of last year, and may reach 2,700,000 bales.*

I regret to observe, from official correspondence and during a brief tour through the cotton States, the tendency to neglect other crops and concentrate all available labor and capital upon a single product, however profitable. The inevitable result will be more cotton and smaller net returns in money after the purchase of needed supplies, and, as a further result, a slower improvement of neglected lands. This bane of southern agriculture is still operative, and may cease to exist only when low prices, disaster, and despondency shall again arrest the impolitic

* Six weeks later, the season proving unusually favorable, this estimate was advanced to 3,000,000 bales.

and irrational course of production. I would not advise an attempt to keep up prices by limiting the yield; a somewhat larger supply of the staple is needed in the markets of the world; the present rates cannot be sustained indefinitely; but I would not foster the suicidal mania for cheapening the money-producing crop while rendering dearer every other that must be purchased as an auxiliary of its production.

It is gratifying, however, to note the increase of cotton manufactures in the cotton region, their flourishing condition, their large dividends, and the quality of their yarns and fabrics. Operatives are easily obtained, at reasonable wages, becoming readily inured to habits of systematic industry, and rapidly acquiring the requisite skill. At the commencement of the present year there were eighty-six cotton mills reported from Southern States to the National Association of Cotton Manufacturers and Planters, running 225,063 spindles, consuming 31,415,750 pounds. The following are details of returns from the cotton States:

State.	Mills.	Spindles.	Average yarn.	Cotton spun.	Average per spindle.
Virginia	10	36, 060	$15\frac{7}{8}$	4, 010, 000	111. 18
North Carolina	17	24, 249	$10\frac{1}{2}$	3, 537, 000	145. 85
South Carolina	6	31, 583	$13\frac{5}{8}$	4, 174, 100	132. 14
Georgia	20	69, 782	$12\frac{3}{8}$	10, 864, 350	155. 70
Alabama	8	25, 196	17	2, 820, 596	112. 00
Mississippi	6	8, 752	9	1, 457, 000	166. 48
Texas	4	8, 528	$9\frac{1}{2}$	1, 372, 104	160. 90
Arkansas	2	924	$8\frac{1}{3}$	258, 400	268. 83
Tennessee	10	13, 720	10	1, 847, 200	134. 00

The cotton manufactured in the United States in 1860 was 422,704,975 pounds; in 1868, by these returns, 450,000,000 pounds. At the former date the home consumption was twenty per cent. of the crop; it is now forty per cent. As the ratio of consumption shall be further increased, the prosperity of the country and of the cotton section will advance.

The sugar interest is rapidly attaining its former proportions. A disposition is indicated to extend its culture beyond the cane plantations of the Mississippi River to Florida, Southern Georgia, and Texas. Fruit culture is gaining a prominence which it never before enjoyed; vineyards of hundreds of acres in extent have been established, and orchards of thousands of acres, with groves of oranges and other tropical fruits. There is evidence of progress also in the use of improved agricultural implements, the employment of fertilizers, and in the mental activity and spirit of inquiry which are moving the rural mind of this section.

THE WHEAT CULTURE.

The wheat interest is at present suffering from one of the periodical seasons of depression which are the inevitable result of exclusive reliance upon a single crop. A good yield was obtained last year, and a

still larger result the present season; this fact, in combination with financial causes, has depressed the price to a lower point than has been reached since 1860. The continuous planting of the new lands of the West with wheat is removing westward, year by year, the center of wheat production, and increasing the distance of transportation, while the railroads, by their combination and advance of tolls to secure dividends upon watered stock, are increasing in equal ratio the cost of freights. Thus are wheat-growers reaping the fruits of their own improvident husbandry, and suffering extortion and loss from the accident of location. A diversification of industry, both agricultural and manufacturing, will render them masters of the situation, and release them from subservience to the railroads and European wheat markets. The pioneer or "skinning" system of culture must be abandoned, at least in the settled States, and capital be used in farm improvements. A judicious investment in draining often pays one hundred per cent. the first year; a single horse-hoeing of growing wheat, as reported to this Department, has doubled the yield, and paid a thousand per cent. upon its cost; and improvement in breeds of farm stock yields large dividends upon the investment.

HOLDING NON-PRODUCTIVE LANDS UNPROFITABLE.

The greed for the acquisition of land is a serious bar to progress in farm improvement. The aim of the pioneer has been, not to become a good farmer, but a holder of broad acres--to grow more wheat, to buy more land. The result is a sparse settlement, poor roads, straw stables, few farm improvements, and a slow advance in prices of real estate after the first sudden rise in values. It is a dangerous fallacy that non-productive farm lands are profitable. Excepting only a brief period of frontier development and proximity to rising cities, the causes which influence the advance of prices of such lands can never swell the coffers of capital like the wonderful accumulating power of compound interest.

The following table, showing the increase of the assessed valuation of farms between 1850 and 1860, a period of great agricultural activity and almost unexampled advance in prices of farm lands, points to the folly of expecting to realize wealth from the soil except by its judicious cultivation:

States.	1850.	1860.	Increase per acre per annum.	Increase per centum per annum.
Maine	$12 04	$13 73	$1 69	1.44
New Hampshire	16 28	18 61	2 33	1.45
Vermont	15 35	22 05	6 70	4.39
Massachusetts	32 50	33 91	4 41	1.31
Rhode Island	30 81	37 50	6 67	2.11
Connecticut	30 50	36 27	5 77	1.82
New York	29 00	38 30	9 30	3.22

Table showing the increase of the assessed valuation of farms, &c.—Continued.

States.	1850.	1860.	Increase per acre per annum.	Increase per centum per annum.
New Jersey	$43 67	$60 41	$16 47	3.73
Pennsylvania	27 33	38 91	11 58	4.21
Delaware	19 74	31 29	11 55	5.65
Maryland	18 81	30 18	11 37	6.08
Virginia	8 27	11 94	3 67	4.45
North Carolina	3 23	6 03	2 80	8.62
South Carolina	5 08	8 62	3 54	6.93
Georgia	4 19	5 89	1 70	4.02
Florida	3 96	5 62	1 66	4.13
Alabama	5 29	9 20	3 91	7.34
Mississippi	5 21	12 42	7 21	13.82
Louisiana	15 19	22 02	6 83	4.41
Texas	1 43	3 47	2 04	14.29
Arkansas	5 87	9 57	3 70	6.31
Tennessee	5 15	13 12	7 97	15.43
Kentucky	9 14	15 21	6 07	6.63
Missouri	6 49	12 04	5 55	8.53
Illinois	7 15	19 55	12 40	17.33
Indiana	10 66	21 76	11 10	10.41
Ohio	19 93	33 12	13 19	6.63
Michigan	11 83	22 87	11 04	9.33
Wisconsin	9 58	16 61	7 03	7.33
Minnesota	5 60	10 14	4 54	8.13
Iowa	6 08	11 90	5 82	9.54
California	99	5 58	4 59	46.36
Oregon	6 58	7 37	79	1.24
Utah	6 65	14 82	8 17	12.25

RAMIE.

The *Boehmeria nivea*—the name under which the new botanical classification for what was formerly designated *Urtica nivea*—known in commerce as China grass, and locally as ramie, and by many other synonyms, has been disseminated throughout the South, and is beginning to be cultivated in extensive plantations. I have given much attention to the propagation and dissemination of this plant, with a full appreciation of its capabilities, and an earnest endeavor to aid in overcoming the mechanical difficulties which at present limit its use in textile productions, and I have witnessed with regret the unenlightened enthusiasm and unreliable statements by which interested propagators have discredited an enterprise which should have a fair and successful trial. The value of the fiber is unquestioned; its use could be largely extended if it were properly prepared for market; and its ultimate success will depend, not upon the facility of its culture or the suitableness of climate, but upon the economy of its manufacture. A prominent manufacturer in Bradford, England, expresses the opinion that it will become a staple fiber, and in some degree supply the place of cotton or wool, if it can be

procured for £45 to £50 per ton, or ten cents per pound. There is a present limited demand for it at £70 per ton. He states that American planters are injuring their interests by their manner of preparing the fiber, declaring all samples received, from which attempts have been made at discharging the gum, to have been tender, nearly decayed, of bad color, and entirely without luster. No reliable machine for stripping the fiber and taking off the outer bark has yet been put in operation. Such an invention may do much toward deciding the practicability of placing this among the valuable and permanent products of our agricultural industry.

CINCHONA.

I have, in a former report, called attention to the propriety of the cultivation of the Peruvian bark tree within the limits of the national domain, and would again urge the necessity which exists for establishing a cinchona plantation at the point most suitable for its healthy growth, and I trust that a liberal appropriation will be made for this purpose.

INTERNATIONAL EXCHANGES.

The system of international exchanges recently adopted by the Department has been continued during the past year with gratifying success, and arrangements have been completed, in addition to those announced in my last report, with the governments of Brazil, Bavaria, Russia, Switzerland, and Honduras; the Horticultural Union Society of Berlin, Prussia; the Royal Society of Brussels, Belgium; the Royal Gardens of Madrid, Spain; the Horticultural Society of Bremen, Germany; the governor-general of Vilayet, Turkey; the Royal Meteorological Society, London; the Scottish Meteorological Society, Edinburgh; and the Agricultural Society of Sydney, New South Wales.

Relations of exchange are now existing with nearly three hundred learned agricultural and industrial societies, chiefly European, but some of them in Asia, Africa, and South America. In nearly every case in which the proposition for exchange has been made, the response has been prompt and favorable. In many cases the societies, in addition to their own publications, have presented to the Department valuable works published by private parties. Several governments have also presented their publications upon agriculture and kindred subjects.

During the year one hundred and three varieties of American tree seeds have been sent to the Botanical Garden, Melbourne, Australia; similar asortments to the royal Minister of Agriculture, Austria; to the Botanical Garden near London, England; and to the Botanical Garden, Madrid, Spain. To the Agricultural Society of Good Hope thirty-two packages of cereals have been sent; fifty pounds of American cotton seed to the Chinese government; one hundred and thirty pack-

ages of vegetable seeds to the Japanese government; and one hundred and thirty-four papers of American tobacco seed and eighty-six packages of cereals to the republic of Liberia, Africa. Donations of a similar character, for experimental purposes, have been received from the principal countries of Europe, from colonies of Great Britain, from Central and South America, from the Chinese and the Japanese government, and from the West Indies.

THE LIBRARY.

During the year nearly one thousand volumes have been added to the library, the additions consisting exclusively of works upon the special interests committed to the charge of the Department. A portion of the books have been purchased, but the larger number have been received in exchange for publications of the Department. The additions made are of great value, being fresh and reliable records of the progress of agriculture and collateral sciences throughout the world, including new discoveries in botany, geology, natural history, chemistry, meteorology, &c. The Department is also in receipt of all the prominent agricultural journals, both foreign and domestic, which of themselves will soon constitute a reference library of value.

DISEASES OF STOCK.

The numerous epizootic and zymotic diseases by which our cattle are infected demand the intelligent consideration of the general government and of the several States. Besides the ordinary diseases to which cattle in open pasture are subject, there is much suffering and loss produced by the restraint and unhealthy conditions in which our domestic animals (especially the cow and the horse) are placed, in disregard of their natural habits and of the well-known laws of hygiene. Simple humanity, irrespective of any pecuniary consideration, would dictate that the services of these useful animals should be rewarded by proper care and attention; but when it is known that several of the diseases which are produced by our neglect of animal comfort are continually communicated to man—small-pox, typhoid fever, and glanders among the number—it would seem to be the duty of the government not only to direct the attention of the agricultural community to the want of care of stock and to the general ignorance of appropriate treatment, but also to encourage the establishment of institutions where veterinary medicine and hygiene, in their widest application, may be taught, and a class of practitioners be produced capable of solving the problem—how to preserve domestic animals in good health under conditions not natural to the species. The experience of the past few years has demonstrated the increased necessity of such facilities, and I therefore strongly recommend the establishment of a division of veterinary surgery in connection with this Department.

THE ANNUAL REPORT.

A change has been effected in the matter and style of the annual volume of Department transactions, which will enhance its value and enlarge its usefulness. Exhaustive treatises upon special topics by private individuals have been discarded, and in their places are presented, under the report of the Editor, digests of official researches upon popular and timely topics, suggested by the exigencies of the hour and illustrative of the direction of rural progress. These investigations, instead of being conducted by a single individual from private resources, are made with the aid of a large corps of special correspondents, officers of industrial organizations, diplomatic representatives of the country abroad, and experts in special branches of rural technology. While the co-operation of experts is thus secured, the unity and consistency of the work is not marred by dissimilar views and irreconcilable differences of fact and opinion. It is believed that this plan will enhance the practical value of the volume, and render it more legitimately a report of official operations and a record of agricultural progress.

CHEMICAL DIVISION.

The work of the chemical division has been considerably increased. The number of analyses performed has been greater than in previous years, while the information given, orally and by letter, to parties applying for assistance on matters of industrial chemistry, has occupied more working time and has been more comprehensive than ever before. The general operations of the laboratory have embraced analytical work for agricultural communities and societies in various parts of the country, for individual farmers and others, for large industries, and for other departments of the government. The laboratory has been rendered more efficient by the purchase of additional apparatus, but the outfit is not yet complete. The collection of minerals deemed necessary to illustrate agricultural and economical geology is in course of formation, and valuable specimens are being received from time to time from various sections of the country, cases for the exhibition of which are being constructed.

THE MUSEUM.

The agricultural cabinet or museum of the Department has been enlarged and improved during the year, and gives renewed evidence of usefulness as a means of reference in agricultural and industrial arts. Valuable donations are being received from individuals and societies in all quarters of the globe. During the past year the Department has received from various parts of the country many valuable additions to the museum of fruits, grains, seeds, and fibers, both animal and vegetable; especially a very valuable collection from the Smithsonian Institution, comprising fibers used for manufacturing purposes; specimens of natural history, insects, &c., from the Army Medical Museum; together

with economic substances, such as farina, gums, resins, materials used for dyeing, and specimens of insects, and various roots and seeds used by the Indians either as food or for medical purposes. Additional cases will be required for the accommodation of accumulating material.

Applications have been received for duplicate models of local fruits for State museums, and valuable varieties of southern fruits, native seedlings, almost unknown to the country at large, should be added to the present collection; and a small appropriation will therefore be asked to renew the work of modeling new and approved varieties of fruits.

No provision has yet been made for the exhibition of the large collection of insects injurious or beneficial to agriculture. Suitable cases, in which to classify and arrange them, will be prepared as means for such improvements are provided; and additional facilities will thus be furnished to the students of practical entomology for the prosecution of their investigations in an important field of science.

THE BOTANICAL COLLECTION.

During the past year the botanical division of this Department has been reorganized and placed in charge of a scientific and practical botanist. The large collection of plants derived from the various government explorations and surveys, which have heretofore been placed in the custody of the Smithsonian Institution, have been transferred to this Department, and are now arranged in suitable cases for convenient study and reference, constituting the nucleus of a national herbarium. The specimens already arranged are estimated to number fifteen thousand, and the regular additions will probably amount to two thousand species annually. The value of this collection is much enhanced by the fact that it comprises the typical specimens from which many of the new species have been described. They have been authenticated by Professors Gray and Torrey, to whom they were referred for study and examination. During the past season valuable additions have been made from correspondents in different parts of the country, including, especially, a set of Florida plants collected by William M. Canby; Texas fungi and grasses, from W. H. Ravenal; and plants of New Mexico and Arizona, from Dr. E. Palmer. Large collections are also expected from the recently completed geological survey on the 40th parallel, by Clarence King, and the expedition of Professor F. V. Hayden, during the past season, in Colorado and New Mexico. From all these sources it is expected that present deficiencies will be supplied and material afforded for profitable exchange, and a collection eventually be secured that will prove attractive to botanical students of this country and of other lands. The correspondence connected with this branch of the Department is already quite extensive, and many questions of botanical or economic interest relative to our native and cultivated plants are daily received and answered.

BOTANICAL EXPLORATIONS.

The Department has not been able to enter upon any extended system of exploration for the purpose of determining the natural vegetation, agricultural resources, and botanical productions of districts remote or little known; yet sufficient has been accomplished in this direction to show the advantages of such investigations on a more extensive scale. In connection with the investigation instituted to develop the character and cause of the "Texas cattle disease," H. W. Ravenal, the well-known Southern botanist, visited Texas last spring for the purpose of observing and collecting the native fungi, supposed by many to have some direct connection with the cause of this formidable disease. He collected such material as the early season afforded to represent these obscure forms of vegetable growth, and this collection, comprising nearly three hundred distinct species of fungi, properly arranged and labeled, is now deposited in the Department herbarium. Six hundred species of native grasses and other plants were also secured. He has recently been engaged in collecting seeds of rare trees and shrubbery in the vicinity of Aiken, South Carolina, which have been forwarded to the Department for experimental propagation and distribution; and for their proper authentication dried specimens have been preserved and placed in the Department herbarium.

In connection with the Smithsonian Institution, arrangements were made last spring to send a competent collector in natural history to Western New Mexico and Arizona, a region known to contain among its vegetable products valuable fibers, nutritious grains and roots extensively used by the Indian tribes in that district. Dr. Edward Palmer, a successful collector heretofore in that section, undertook a further exploration, in the early part of the season, and has been diligently occupied in collecting specimens in ethnology and natural history, which have been forwarded to the Department, with statements of their habits and economic uses. Of the rare plants, including several new species contained in the collections thus far received, duplicates, as far as they can be spared, have been sent to the different standard herbaria. The extensive collection of dried plants recently transferred from the Smithsonian Institution still continues to receive large additions from the same source. Recent government surveys are also adding constantly to this accumulating stock, and by direction of the Surgeon General of the United States Army the medical staff has been authorized to aid in such collections at different frontier military posts.

During the past fall the botanist of this Department, Dr. C. C. Parry, made a personal exploration of Central and Western Kansas and Eastern Colorado, as far as the base of the Rocky Mountains, where collections of native forage grasses, ornamental plants and shrubbery, wild grain seeds, and fiber-producing plants were successfully made. Special attention was given to the timber growth and the agricultural and

pastoral capacities of this district, which has recently assumed a rapid development.

THE EXPERIMENTAL GARDEN.

The chief objects of this garden are the propagation of plants of national interest and the testing of the merits of new varieties. The impression seems to prevail that the Department proposes to furnish plants of every description to all who make application, and orders, precise and exacting as could be given to a commercial establishment, are frequently received for the most common varieties of trees and plants. The impropriety and impracticability of meeting such demands scarcely need to be stated, so inconsistent with the intention of Congress would be such promiscuous and general distribution, and so disproportioned to the limited appropriation for this branch of the Department. Special regard has been paid in the distribution made to the selection of the best localities for the trial of new varieties of plants deemed worthy of introduction and more general propagation.

The number of plants sent out from the garden during the year is 31,700. Collections of native grapes have also been sent to the Jardin des Plantes, Paris, and to the Kew Gardens, and the gardens of the Horticultural Society in England. From the Kew Gardens there have been received a valuable collection of species of the cinchona or Peruvian bark tree; *Aralia papyrifera*, the paper plant of China; several *Musas* and New Holland plants; and an extensive collection of seeds of hardy shrubs and trees from various countries, for use in the arboretum now being formed in the Department grounds. Seeds have also been received in exchange from the government gardens at New South Wales, Australia, and from other foreign countries.

DISTRIBUTION OF SEEDS.

There have been issued from the Department, from December 1, 1868, to December 1, 1869, 311,802 packages of seeds, including varieties of vegetables, flowers, wheat, rye, barley, oats, ramie, tobacco, clover, rice, cotton, and sorghum, distributed as follows: To members of Congress, 111,975; agricultural societies, 64,975; correspondents of the Department, 65,274; meteorological observers, 13,016; miscellaneous, 67,379. Reports of the success attending experiments with seed distributed are daily received, a digest of which is published in the monthly reports, and some of the more notable are given in the accompanying reports of annual transactions. Especial attention has been given to the introduction of the best varieties of cereals suited to the different climates and soils of the country. These have been very widely disseminated, and meet the warm approbation of farmers in every section of the Union.

The testimony of experimenters during the present year has established, by an overwhelming voice, the great utility and public economy

of the present system. But it is apparent, upon the least reflection, that the quantity of seeds and plants for which the congressional appropriation provides is by no means commensurate with the importance of the object. The direct effect of this limited distribution is clearly indicated by its reported results. It is susceptible of demonstration that a judicious distribution of seeds will increase production to the extent of several millions of dollars.

THE DEPARTMENT GROUNDS.

The improvement of the grounds is progressing as rapidly as the limited means provided will admit. The composite roads continue to give satisfaction, presenting a hard, clean surface at all seasons and in all changes of weather, and when properly made they are economically kept in condition, being altogether exempt from grasses and weeds, so injurious to graveled roads and walks.

The planting of the arboretum was commenced early in the season; one-half of the entire list was set out, and, notwithstanding the unusually arid summer, few losses have occurred. The completion of this collection is eagerly urged by those who appreciate its importance and value to the practical arts as well as to botanical science.

We cannot overestimate the benefits that must necessarily result from a collection of plants whose products are of commercial value in the arts, manufactures, and medicine. The mere exhibition of such collections, when systematically arranged, is productive of much good; and the impetus that is now being given to a diversification of products, especially in the warmer latitudes of this country, calls for a more intimate knowledge of the various oil, gum, sugar-bearing, and fiber-producing plants of the world.

Although we may assume that all plants (except extra-tropical) will flourish in some portion of our country, the question of profitable production does not in all cases depend alone upon geniality of climate or proper soil; the kind as well as the amount of manipulation necessary to secure a marketable commodity must be taken into consideration before entering into competition with other countries. As an example, it is well understood that the tea-plant may be grown to perfection over a large extent of country, but the amount of manual labor required in its preparation for commerce precludes the possibility of competition with the very cheap labor of China. Where machinery can be advantageously employed, the question assumes a different aspect, rendering it probable that many articles now imported at great cost may be profitably produced in this country.

INSUFFICIENCY OF CLERICAL COMPENSATION.

The inadequate rates of compensation attached to responsible positions in this Department are a bar to the highest efficiency of the serv

ice. I have been unable to obtain, in competition with private business, a sufficient number of trained and skillful workers in the various departments of agricultural investigation, and can only expect to retain those who have wrought efficiently in the work already accomplished at a sacrifice of their personal interests for the public good.

The most laborious walks of chemical, natural, and social science must necessarily be explored; the rarest wisdom and ripest experience in practical affairs are demanded daily; and enlightened zeal and untiring industry are absolutely requisite to grasp and master the agricultural problems of a continent in this era of progress. It is a matter of grave necessity that relief should be afforded and the efficiency of the Department increased; and it is sincerely to be hoped that Congress will without delay classify anew the clerical grades, and increase the compensation for skillful and able service.

FINANCIAL.

There has been expended since November 30, 1868, the date of my last report, the sum of $176,698 50, leaving a balance unexpended of $90,000, for the remainder of the fiscal year ending June 30, 1870.

A general regret has been expressed, from all sections of the country, that the appropriations to this Department are so small, when the opportunities for stimulating agricultural progress and increasing production are so various and fruitful. Surprise is especially felt that some of the more important items of the appropriation have been so greatly reduced within two or three years past. The South is calling for information, investigation, increase of products, and improvement of varieties; other portions of the country are making reasonable demands upon the resources of the Department beyond its ability to supply. A little system infused into our proverbially unsystematic agriculture would annually increase the value of farm crops by a sum far larger than the annual interest on the national debt, and a partial remedy for deterioration in seed would prove an equal advantage. It cannot be doubted that this Department should do much, with adequate support, in both these directions. A larger appropriation is, therefore, respectfully urged upon the attention of Congress.

HORACE CAPRON,
Commissioner of Agriculture.

His Excellency ULYSSES S. GRANT, *President.*

REPORT OF THE STATISTICIAN.

SIR: In presenting a report of the statistics of agriculture for 1869, I am admonished of the difficulty of correctly estimating the productions of agricultural labor by the extent and variety of the interests involved, the fluctuations in quantity annually produced by changes in price, the unsystematic character of our agriculture, and the difficulty of obtaining full reports from every section of an area continental in extent. As the annual estimates are based upon the results of the census, the schedules of which are so incomplete as scarcely to furnish half the information reasonably expected and constantly demanded by the public, the difficulty of making an exhibit satisfactory in its completeness and variety is greatly increased. The fundamental fact in agricultural enumeration, that of *acreage*, of more importance even than quantities produced, and the first undertaking in a European census of agriculture, has never been ascertained in this country, and is not included in the enumerations of the present year. It is vitally important in illustrating the value of rotations, the effect of high culture, and in instituting comparisons involving the entire range of scientific farming. Our census is founded essentially upon a commercial idea; it ignores some of the first principles of rural economy and agricultural progress, and aims only to ascertain what is available for consumption and exportation; it appears to be based on the idea that we are a nation of speculators and traders rather than producers.

A systematic effort has been made to *estimate* the acreage by a careful and deliberate calculation in each county, and the proper averaging of the local estimates. The ultimate results are verified and modified by another mode of reaching a similar result, by dividing the aggregate quantities, as found by yearly comparisons based on the results of the decennial census, by the estimated average rate of production per acre. If it shall be urged that the results must be unreliable, it is suggested that guesses will be inevitably made, and that a closer approach to reliability is thus secured than can be attained by any other practicable means. It is undeniably true that estimates made from skillful combination of elementary facts, and tested and proven by the result of parallel combinations from different data, are often more nearly accurate than an incomplete official census, such as many of those prepared from assessors' returns, which become the basis of taxation, and are therefore inevitably partial. In many such cases scarcely half the production is reported. Even in that of Ohio, the most reliable of all State exhibits, the assessors' returns of wheat in 1860 made an aggregate less than that of the census of the United States by about three millions of bushels, or a decrease of twenty per cent.

Crops of 1869.—The year has been peculiarly favorable for cereals. The quantity of wheat secured is larger than the aggregate of any previous year. The corn crop was smaller than that of 1868; that of barley represents an increase of at least twenty-five per cent.; oats an advance of 33,000,000 bushels; rye makes no material gain; and buckwheat alone shows a retrograde movement. A large increase in the aggregate for potatoes appears, in which the West and Central States share liberally.

Our estimates of acreage allow, in round numbers, seventy millions of acres for cereals and potatoes, and of this more than one-half is in the national crop, maize; and more than a fourth is in wheat, leaving scarcely fifteen millions in oats, barley, rye, buckwheat, and potatoes. Cotton,

tobacco, rice, hemp, and flax, include about ten millions more, making eighty millions in leading field crops. A great variety of minor crops, with lands in fruit and vegetable culture—specific estimates of which have not been attempted—would swell the acreage in all tillage crops to nearly one hundred millions. The hay crop, as estimated, requires eighteen and a half millions more. As a small portion only of the grazing lands of the country are inclosed, it is impracticable to assume the actual area in pasturage. The census of 1850 made the "improved" land 113,032,614, and the "unimproved" 180,528,000; that of 1860, 163,110,720, and "unimproved" 244,101,818. The area in farms should now be 500,000,000 acres or more. The term "improved" includes all fallow and other temporarily uncultivated land—"resting" a field being the popular American substitute for rotation. The extent of our resources for future cultivation of the soil is shown by the comparison between these areas of tillage or other culture, and the total acreage of the country, which amounts to 1,926,636,800, exclusive of Alaska, estimated to contain 369,529,600 acres more, with a very small proportion of tillable soil. Thus less than a fourth of our area is at present occupied by farms, and less than a tenth is under tillage and in meadow or permanent pasture; while the total area under crop in England is said to be 71 per cent., in Ireland 76 per cent., and 53 per cent. in all Great Britain. England, one-fifth larger than the State of Ohio, with an area of 32,590,000 acres, has 23,370,000 acres under crop. Ohio, with a soil naturally richer, has six to seven millions annually under crop, showing a large reserve of capacity for a future increase of population in one of the most populous of our States.

The value of wheat, rye, oats, and potatoes has greatly declined during the year, yet the total value of all the cereals, with hay, cotton, and tobacco, is somewhat increased, being placed at $1,849,179,843. Indian corn, heading the list, is estimated at $658,532,700; hay, $337,662,600; cotton, $303,600,000; wheat, $247,099,120; oats, $137,347,000.

The relative values of the yield per acre, as affected by prevailing prices, stand in the following order: Tobacco, potatoes, cotton, barley, hay, corn, buckwheat, oats, rye, wheat.

In the summary of values of each crop per acre Vermont is credited with the highest sum, $47 60, for corn; New Hampshire, with the exception of the Territories, stands first in value of wheat, $28 18 per acre; and Connecticut obtains the highest price, $391, for an acre of tobacco. The element of price is thus found to be a compensation in the East for lack of the abounding fertility of the West.

A general tendency to enlarge the meat production of the country is manifest, especially in the districts hitherto assigned to wheat-growing. The all-controlling motive, superior profit in the present, has doubtless actuated the majority, but there are those, even in the fertile West, who begin to take into consideration the restorative character of cattle-farming, and its superior economy of the elements of fertility in the soil and in the atmosphere.

Wheat.—Rarely has the wheat plant met so few disasters throughout so wide a territory. The winter variety, in its more northern range, was generally well covered with snow until the opening of spring, and in its southern belt the alternations of frost and sunny temperatures were neither extreme nor sudden. The trying month of March wrought partial disaster in exposed situations, where slothfulness or ignorance had failed to put the soil in proper condition and the seed in its proper place. Where the drain tile and the grain drill wrought together in the same field, even the heaviest clays bore a uniform and abundant burden.

The temperature of May and June was lower than usual, and the crop ripened and was harvested in the region between 36° and 40°, the chosen latitude of the best winter wheat, before the occurrence of severe summer heats, which so often shrivel the grain in premature ripening or blight it with rust or scab. In large districts an excess of rain gave great growth to the stalk and a succulence which favored "lodging," from which comparatively small losses were experienced, the heavy rains measurably subsiding in season for the filling and hardening of the head. The low temperature and the continued moisture continued to occasion slow maturity and a late harvest. A very general exemption from insect ravages has been observed. Thus the season was exceptional and a crop secured larger than usual, estimated at about 260,000,000 bushels. The quality, as a whole, may be assumed to be a fair average, though there was a proportion of spring grain that was immature or damaged after harvesting. Other grains averaged better than usual, particularly oats and barley. The season was not so favorable for buckwheat.

Corn.—A very large breadth of maize was planted—large areas of it with much difficulty, between showers, in a saturated soil in many cases, where it was left to rot and to be subsequently replaced, in some instances a second time. It started slowly and presented a discouraging aspect till midsummer, when the weather became more favorable, and the crop assumed a look of health and vigor, giving promise of a partial reparation for its early shortcomings. Still the summer proved comparatively unpropitious to the end, a severe drought pinching and shriveling it in the Atlantic States of the South, and cold nights preventing growth and maturation in the North. An early killing frost would have wrought wide-spread disaster; but the mild and sunny weather of September and late coming of heavy frosts relieved greatly the expected reduction in quantity and saved at least a hundred millions of dollars in a crop more needed than any other. Yet the yield, estimated at 874,320,000 bushels, has been less by 150,000,000 bushels than a good return should bring upon the same acreage. The quality, although quite variable, is not up to an average.

Hay.—This great crop, second in importance only to that of corn, and of greater value than cotton, has been one of more than average quantity, but slightly under an average in quality. In portions of the West it is watery, immature, and much of it cured imperfectly. In the Southern States it is of excellent quality, except in thin and parched soils or when cut too late. As the main dependence of farm stock in winter, in the absence of mangolds and turnips, a full supply of good quality is a consideration that cannot be ignored, and the extent of the benefaction which should double its production can scarcely be overestimated.

Cotton.—The high prices of 1868 stimulated the extension of cotton fields, and a breadth of nearly a million of acres was added to the area under cultivation. The history of the crop shows that "a bad beginning" in cotton may sometimes make a "good ending." In the monthly report for June it was stated: "Complaints of late planting, bad stands, cold and unfavorable weather, are more or less general throughout the cotton States;" and thereupon, in view of the enlarged breadth and extensive use of fertilizers in the more eastern States, it was said: "It is not too late, with good weather and exemption from insects, to obtain a yield of 3,000,000 bales." In July steady progress of recuperation was noted: "The feebleness and starved appearance of the plant in May and early June are yielding to the bright suns and genial showers of the progressing season, which are rapidly repairing all damages except the lack of a perfect stand." Still there were places where but half a

crop was expected; and in the most fertile portion of the cotton region bordering upon the Mississippi the plant was "two or three weeks later than usual," yet green and vigorous, promising, "with a favorable season, to be nearly as far advanced as usual the 18th of August, the time to commence the first picking." In September a drought on the seaboard was reported, threatening a reduction of yield, while westward to Texas the prospect for a large yield brightened with the increasing distance, and the first prediction of the season was made—"the probabilities at present favor a yield of 2,750,000 bales." In view of the acreage and condition of the crop while the first picking was in progress, and three more in the uncertain future, subject to the contingencies of frosts and storms, the contingent estimate was quite as liberal as could be honestly made. Up to October there was no reason for advancing it, but the remarkable character of the autumn season, almost frostless and rainless, matured the bolls and permitted uninterrupted picking until the beginning of the new year, and added fully ten per cent. to the yield of an average season, rendering it necessary, upon the tabulation of the final returns, to place the estimate at 3,000,000 bales, the result hinted at as possible in the summary of the first returns of the season. The prediction of the effect of such a crop—a decrease in price of twenty-five per cent.—has also been realized. It is to be hoped that planters will learn wisdom from experience, and hesitate before pushing production beyond the limit of reasonable profit, and incurring the necessity of purchasing supplies for man and beast from an empty purse.

The value of the crop of 1869, as compared with the great yield of 1859, enforces this lesson of self-dependence and equilibrium of rural production. In 1859, 2,154,820,800 pounds, at 11 cents, realized $237,030,288; in 1869, 1,380,000,000 pounds, at 22 cents, realized $302,600,000. Adopting these figures as sufficiently accurate for the purposes of this comparison, the crop of ten years ago brought $65,569,712 less than the present one, though the quantity was 774,820,800 pounds greater. Suppose the next crop should reach 3,500,000 bales, of 460 pounds, worth 15 cents per pound, the total value would be $241,500,000—a loss of $61,100,000 upon an increase of half a million bales. To this sum of $61,000,000 an equal additional loss would be added for purchases of supplies abroad which might have been grown at home.

The cotton interest has already attained its maximum of value and profit for the present, and the cotton supply of the world has nearly reached the limit of normal consumption; at a lower price a somewhat larger consumption might result; a largely increased supply would occasion disaster and fluctuation in production, disadvantageous alike to planter and manufacturer. There is one mode, and but one, by which the value and profit of the cotton crop can be largely increased, and by which cotton growers can remain "masters of the situation," and that is by manufacturing in this country, not twenty per cent. of the crop, as in 1860; not thirty-five per cent., as in 1869; but at least seventy-five per cent.; and half of this should be manufactured, near the cotton fields, into coarse goods at first, largely into yarns, and ultimately into every variety of cotton fabrics. It can be done with profit at once. Idle water powers, abundant and cheap wood and coal for steam machinery, dependent women anxious to earn a livelihood, and children growing up under the pernicious influence of idleness, call for such utilization of wasting resources. While these means of opulence are ignored, and the children of indigence are permitted to pine in poverty, it would be unmanly to envy the possession of wealth elsewhere obtained by the persistent and industrious utilization of similar resources; and while

such opportunities are thrown away, the highest prosperity must not only be unattained, but undeserved.

It is gratifying to note the increase of manufacturing in the cotton States. The following table is a synopsis of returns to the Cotton Manufacturers' Association, up to October, 1869, giving the number of mills in operation, the number of spindles, the size of yarn, and quantity of cotton used:

States.	Mills.	Spindles.	Yarn.	Cotton spun.	Average per spindle.
Virginia	7	27, 148	14½	2, 263, 163	83. 80
North Carolina	15	20, 743	12⅓	2, 486, 741	120. 13
South Carolina	5	29, 084	12⅓	3, 582, 595	123. 54
Georgia	26	73, 556	12¼	9, 909, 947	133. 92
Alabama	8	27, 364	15½	2, 460, 738	89. 94
Mississippi	3	3, 332	8⅝	242, 000	72. 63
Texas	2	1, 716	9⅝	209, 300	121. 97
Arkansas	1	516	10	95, 363	184. 81
Tennessee	7	9, 800	11½	735, 071	75. 00
Kentucky	2	4, 500	9	788, 795	175. 29
Total	76	197, 759	12¾	22, 773, 718	115. 02

Should three-fourths of the crop be manufactured in this country, the remaining fourth would be sought with avidity, whatever the yield of the staple in India or elsewhere; good prices would be maintained, and the gain of the manufacture would be added to the profit of the culture, insuring continued and unexampled prosperity to the cotton section.

CROPS OF 1869.

Table showing the product of each principal crop of the several States named, the yield per acre, the total acreage, the average price in each State, and the value of each crop, for 1869.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
MAINE.					
Indian corn ... bushels	1, 450, 000	24. 3	59, 670	$1 27	$1, 841, 500
Wheat ... do	248, 000	15. 4	16, 103	1 83	453, 840
Rye ... do	158, 000	17. 7	8, 926	1 43	225, 940
Oats ... do	3, 200, 000	30. 5	104, 918	68	2, 176, 000
Barley ... do	750, 000	20. 7	36, 231	1 14	855, 000
Buckwheat ... do	350, 000	24. 6	16, 203	83	290, 500
Potatoes ... do	7, 500, 000	128	58, 593	52	3, 900, 000
Tobacco ... pounds					
Hay ... tons	1, 050, 000	. 91	1, 153, 846	15 25	16, 012, 500
Total			1, 454, 490		25, 755, 280
NEW HAMPSHIRE					
Indian corn ... bushels	1, 400, 000	30	46, 666	$1 30	$1, 820, 000
Wheat ... do	291, 000	17. 5	16, 628	1 85	538, 350
Rye ... do	150, 000	15	10, 000	1 38	207, 000
Oats ... do	1, 663, 000	30	55, 433	69	1, 147, 470
Barley ... do	106, 000	27	3, 925	1 05	111, 300
Buckwheat ... do	90, 400	22. 5	4, 0[illegible]0	82	73, 800
Potatoes ... do	4, 500, 000	150	30, 000	45	2, 025, 000
Tobacco ... pounds					
Hay ... tons	700, 000	1. 06	660, 377	15 00	10, 500, 000
Total			827, 029		16, 422, 920

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
VERMONT.					
Indian corn .... bushels	1, 475, 000	34	43, 382	$1 40	$2, 065, 000
Wheat .... do	766, 000	18	42, 555	1 57	1, 202, 620
Rye .... do	155, 000	16	9, 687	1 45	224, 750
Oats .... do	5, 050, 000	35. 6	141, 853	67	3, 383, 500
Barley .... do	102, 000	22. 8	4, 473	1 34	136, 680
Buckwheat .... do	231, 000	20. 6	11, 213	86	198, 660
Potatoes .... do	5, 750, 000	160	35, 937	38	2, 185, 000
Tobacco .... pounds	....	....	....	....	....
Hay .... tons	1, 100, 000	1. 15	956, 521	13 00	14, 300, 000
Total	....	....	1, 245, 621	....	23, 696, 210
MASSACHUSETTS.					
Indian corn .... bushels	1, 950, 000	34. 2	57, 017	$1 32	$2, 574, 000
Wheat .... do	167, 000	18	9, 277	1 75	292, 250
Rye .... do	462, 000	18. 4	25, 108	1 30	600, 600
Oats .... do	1, 525, 000	31	49, 193	73	1, 113, 250
Barley .... do	144, 000	25	5, 760	1 56	224, 640
Buckwheat .... do	85, 000	11. 5	7, 391	1 06	90, 100
Potatoes .... do	4, 300, 000	106	40, 566	68	2, 924, 000
Tobacco .... pounds	5, 200, 000	1, 200	4, 333	26	1, 352, 000
Hay .... tons	850, 000	. 99	858, 585	24 42	20, 757, 000
Total	....	....	1, 057, 230	....	29, 927, 840
RHODE ISLAND.					
Indian corn .... bushels	440, 000	25. 2	17, 460	$1 28	$563, 200
Wheat .... do	8, 600	17	505	1 60	13, 760
Rye .... do	31, 000	14. 2	2, 183	1 40	43, 400
Oats .... do	250, 000	31	8, 064	71	177, 500
Barley .... do	55, 000	23	2, 391	1 28	70, 400
Buckwheat .... do	3, 100	15	206	1 15	3, 565
Potatoes .... do	770, 000	98	7, 857	68	523, 600
Tobacco .... pounds	....	....	....	....	....
Hay .... tons	71, 000	1. 09	65, 137	21 75	1, 544, 250
Total	....	....	103, 803	....	2, 939, 675
CONNECTICUT.					
Indian corn .... bushels	1, 950, 000	31. 2	62, 500	$1 30	$2, 535, 000
Wheat .... do	75, 000	17. 5	4, 285	1 40	105, 000
Rye .... do	837, 000	12. 3	68, 048	1 38	1, 155, 060
Oats .... do	2, 100, 000	33. 7	62, 314	73	1, 533, 000
Barley .... do	25, 000	23	1, 086	90	22, 500
Buckwheat .... do	270, 000	16. 2	16, 666	1 22	329, 400
Potatoes .... do	2, 500, 000	108	23, 148	63	1, 575, 000
Tobacco .... pounds	6, 500, 000	1, 450	4, 482	27	1, 755, 000
Hay .... tons	750, 000	1. 43	524, 475	18 00	13, 500, 000
Total	....	....	767, 004	....	22, 509, 960
NEW YORK.					
Indian corn .... bushels	19, 100, 000	27. 1	704, 797	$1 03	$19, 673, 000
Wheat .... do	9, 750, 000	16	609, 375	1 37	13, 357, 500
Rye .... do	4, 748, 000	14. 5	327, 448	1 03	4, 890, 440
Oats .... do	31, 250, 000	35	892, 857	56	17, 500, 000
Barley .... do	4, 600, 000	24. 1	190, 871	99	4, 554, 000
Buckwheat .... do	5, 590, 000	20. 1	278, 109	86	4, 807, 400
Potatoes .... do	28, 500, 000	114	250, 000	51	14, 535, 000
Tobacco .... pounds	8, 500, 000	800	10, 625	14	1, 190, 000
Hay .... tons	4, 600, 000	1. 54	2, 987, 012	12 66	58, 236, 000
Total	....	....	6, 251, 094	....	138, 743, 340
NEW JERSEY.					
Indian corn .... bushels	9, 200, 000	30. 8	298, 701	$0 95	$8, 740, 000
Wheat .... do	1, 646, 000	16. 5	99, 757	1 34	2, 205, 640
Rye .... do	1, 500, 000	14. 8	101, 351	1 12	1, 680, 000
Oats .... do	6, 440, 000	34. 1	188, 856	57	3, 670, 800

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
NEW JERSEY—Continued.					
Barley .... bushels..	26, 000	24	1, 083	$1 00	$26, 000
Buckwheat .... do....	890, 000	14. 2	62, 676	1 13	1, 005, 700
Potatoes .... do....	5, 300, 000	93	56, 989	62	3, 286, 000
Tobacco .... pounds..	100, 000	1, 300	76	27	27, 000
Hay .... tons..	525, 000	1. 50	350, 000	20 20	10, 605, 000
Total	....	....	1, 159, 489	....	31, 246, 140
PENNSYLVANIA.					
Indian corn .... bushels..	29, 500, 000	31. 4	939, 490	$0 92	$27, 140, 000
Wheat .... do....	16, 500, 000	14. 8	1, 114, 864	1 28	21, 120, 000
Rye .... do....	6, 250, 000	13. 7	456, 204	99	6, 187, 500
Oats .... do....	48, 000, 000	35. 7	1, 344, 537	47	22, 560, 000
Barley .... do....	631, 000	23. 6	26, 737	1 02	643, 620
Buckwheat .... do....	6, 500, 000	16. 4	396, 341	93	6, 045, 000
Potatoes .... do....	15, 400, 000	102.	150, 980	60	9, 240, 000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	2, 570, 000	1. 41	1, 822, 695	14 85	38, 164, 500
Total	....	....	6, 251, 848	....	131, 100, 620
DELAWARE.					
Indian corn .... bushels..	3, 200, 000	18.	177, 777	$0 70	$2, 240, 000
Wheat .... do....	830, 000	13. 5	61, 481	1 28	1, 062, 400
Rye .... do....	35, 000	7.	5, 000	97	33, 950
Oats .... do....	1, 723, 000	10.	172, 300	45	775, 350
Barley .... do....	6, 000	24.	250	90	5, 400
Buckwheat .... do....	12, 000	13.	923	1 10	13, 200
Potatoes .... do....	200, 000	70.	2, 857	65	130, 000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	30, 000	1. 15	26, 086	20 00	600, 000
Total	....	....	446, 674	....	4, 860, 300
MARYLAND.					
Indian corn .... bushels..	12, 300, 000	20. 2	608, 910	$0 73	$8, 979, 000
Wheat .... do....	6, 733, 000	11. 8	570, 593	1 30	8, 752, 900
Rye .... do....	482, 000	12. 3	39, 186	97	467, 540
Oats .... do....	7, 100, 000	19. 8	358, 585	51	3, 621, 000
Barley .... do....	24, 000	23.	1, 043	90	21, 600
Buckwheat .... do....	150, 000	11. 4	13, 157	1 10	165, 000
Potatoes .... do....	1, 050, 000	73.	14, 383	64	672, 000
Tobacco .... pounds..	14, 500, 000	500.	29, 000	13. 3	1, 928, 500
Hay .... tons..	191, 000	1. 16	164, 655	17 95	3, 428, 450
Total	....	....	1, 799, 512	....	28, 035, 990
VIRGINIA.					
Indian corn .... bushels..	17, 500, 000	15. 5	1, 129, 032	$0 91	$15, 925, 000
Wheat .... do....	8, 642, 000	10. 5	823, 047	1 21	10, 456, 820
Rye .... do....	800, 000	9. 3	86, 021	91	728, 000
Oats .... do....	9, 017, 000	17. 1	527, 309	48	4, 328, 160
Barley .... do....	28, 000	17. 3	1, 618	87	24, 360
Buckwheat .... do....	75, 000	10. 7	7, 009	87	65, 250
Potatoes .... do....	1, 188, 000	50.	23, 760	69	819, 720
Tobacco .... pounds..	65, 000, 000	418.	155, 502	10. 3	6, 695, 000
Hay .... tons..	220, 000	1. 46	150, 684	15 41	3, 390, 200
Total	....	....	2, 903, 982	....	42, 432, 510
NORTH CAROLINA.					
Indian corn .... bushels..	17, 400 000	14. 8	1, 175, 675	$1 00	$17, 400, 000
Wheat .... do....	3, 870, 000	8. 4	460, 714	1 53	5, 921, 100
Rye .... do....	400, 000	8. 3	48, 192	1 15	460, 000
Oats .... do....	3, 500, 000	15. 1	231, 788	65	2, 275, 000
Barley .... do....	3, 500	17	205	1 00	3, 500
Buckwheat .... do....	17, 000	30. 2	562	71	12, 070

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
NORTH CAROLINA—Continued.					
Potatoes .... bushels..	675, 000	74	9, 121	$0 80	$540, 000
Tobacco .... pounds..	33, 500, 000	508	65, 944	13. 7	4, 589, 500
Hay .... tons..	160, 000	1. 44	111, 111	12 11	1, 937, 600
Total	....	....	2, 103, 312	....	33, 138, 770
SOUTH CAROLINA.					
Indian corn .... bushels..	8, 100, 000	11. 6	698, 275	$1 40	$11, 340, 000
Wheat .... do....	920, 000	6. 6	139, 393	2 09	1, 922, 800
Rye .... do....	55, 600	5. 4	10, 185	1 68	92, 400
Oats .... do....	850, 000	10. 8	78, 703	95	807, 500
Barley .... do....	7, 400	8	925	1 90	14, 060
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	117, 000	60	1, 950	1 33	155, 610
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	58, 000	1. 25	46, 400	23 33	1, 353, 140
Total	....	....	975, 831	....	15, 685, 510
GEORGIA.					
Indian corn .... bushels..	27, 500, 000	11	2, 500, 000	$1 21	$33, 275, 000
Wheat .... do....	2, 170, 000	7. 4	293, 243	1 65	3, 580, 500
Rye .... do....	73, 000	6. 5	11, 230	1 51	110, 230
Oats .... do....	1, 200, 000	12. 3	97, 560	95	1, 140, 000
Barley .... do....	12, 300	13. 8	891	1 83	22, 509
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	248, 000	61	4, 065	1 40	347, 200
Tobacco .... pounds..	1, 000, 000	375	2, 666	19. 4	194, 000
Hay .... tons..	48, 000	1. 46	32, 876	21 45	1, 029, 600
Total	....	....	2, 942, 531	....	39, 699, 039
FLORIDA.					
Indian corn .... bushels..	3, 100, 000	11. 2	276, 785	$1 45	$4, 495, 000
Wheat .... do....	1, 300	10	130	1 90	2, 470
Rye .... do....	12, 500	9	1, 388	1 50	18, 750
Oats .... do....	23, 000	13	1, 769	1 37	31, 510
Barley .... do....	4, 000	14	285	1 80	7, 200
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	30, 000	75	400	1 70	51, 000
Tobacco .... pounds..	500, 000	500	1, 000	29	145, 000
Hay .... tons..	13, 000	1. 25	10, 400	20 00	260, 000
Total	....	....	292, 157	....	5, 010, 930
ALABAMA.					
Indian corn .... bushels..	30, 200, 000	15.	2, 013, 333	$1 14	$34, 428, 000
Wheat .... do....	930, 000	7. 8	119, 230	1 62	1, 506, 600
Rye .... do....	40, 000	7. 3	5, 479	1 47	58, 800
Oats .... do....	567, 000	12. 6	45, 000	91	515, 970
Barley .... do....	9, 000	11. 7	769	1 81	16, 290
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	312, 000	63	4, 952	1 80	561, 600
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	68, 000	1. 37	49, 635	26 25	1, 785, 000
Total	....	....	2, 238, 398	....	38, 872, 260
MISSISSIPPI.					
Indian corn .... bushels..	30, 000, 000	17. 5	1, 714, 285	$1 12	$33, 600, 000
Wheat .... do....	267, 000	9	29, 666	1 75	467, 250
Rye .... do....	21, 000	7. 7	2, 727	1 70	35, 700
Oats .... do....	200, 000	23. 7	8, 438	98	196, 000
Barley .... do....	8, 000	11	727	1 40	11, 200
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	400, 000	89	4, 494	1 09	436, 000

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
MISSISSIPPI—Continued.					
Tobacco.....pounds..	....		....	....	....
Hay.....tons..	40, 000	1. 16	34, 482	$19 33	$773, 200
Total.....	....	....	1, 794, 819	....	35, 519, 350
LOUISIANA.					
Indian corn.....bushels..	16, 850, 000	25	674, 000	$1 09	$18, 366, 500
Wheat.....do....	50, 000	11. 5	4, 347	1 25	62, 500
Rye.....do....	21, 000	11	1, 909	1 20	25, 200
Oats.....do....	87, 000	13	6, 692	1 15	100, 050
Barley.....do....	....	....	....	....	....
Buckwheat.....do....	....	....	....	....	....
Potatoes.....do....	350, 000	90	3, 888	75	262, 500
Tobacco.....pounds..	....	....	....	....	....
Hay.....tons..	37, 000	1. 50	24, 666	12 00	444, 000
Total.....	....	....	715, 502	....	19, 260, 750
TEXAS.					
Indian corn.....bushels..	23, 000, 000	29	793, 103	$0 73	$16, 790, 000
Wheat.....do....	1, 250, 000	11. 1	112, 612	1 70	2, 125, 000
Rye.....do....	103, 000	17. 3	5, 953	1 10	113, 300
Oats.....do....	1, 250, 000	28. 4	44, 014	70	875, 000
Barley.....do....	60, 000	26. 6	2, 255	1 04	62, 400
Buckwheat.....do....	....	....	....	....	....
Potatoes.....do....	400, 000	112	3, 571	1 60	640, 000
Tobacco.....pounds..	....	....	....	....	....
Hay.....tons..	28, 000	1. 69	16, 568	14 18	397, 040
Total.....	....	....	978, 076	....	21, 002, 740
ARKANSAS.					
Indian corn.....bushels..	25, 750, 000	28	919, 642	$0 92	$23, 690, 000
Wheat.....do....	1, 170, 000	11. 8	99, 152	1 51	1, 766, 700
Rye.....do....	40, 000	12	3, 333	1 35	54, 000
Oats.....do....	550, 000	24. 7	22, 267	75	412, 500
Barley.....do....	4, 000	13	307	1 10	4, 400
Buckwheat.....do....	....	....	....	....	....
Potatoes.....do....	346, 000	76	4, 552	1 00	346, 000
Tobacco.....pounds..	2, 225, 000	750	2, 966	13. 7	304, 825
Hay.....tons..	10, 000	1. 33	7, 518	12 60	126, 000
Total.....	....	....	1, 059, 737	....	26, 704, 425
TENNESSEE.					
Indian corn.....bushels..	47, 500, 000	20	2, 375, 000	$0 77	$36, 575, 000
Wheat.....do....	6, 750, 000	8. 4	803, 571	1 15	7, 762, 500
Rye.....do....	226, 000	10	22, 600	1 00	226, 000
Oats.....do....	3, 500, 000	16. 7	209, 580	60	2, 100, 000
Barley.....do....	28, 000	16. 4	1, 707	1 12	31, 360
Buckwheat.....do....	9, 000	6. 2	1, 451	1 08	9, 720
Potatoes.....do....	1, 000, 000	50	20, 000	73	730, 000
Tobacco.....pounds..	35, 000, 000	548	63, 868	13	4, 550, 000
Hay.....tons..	158, 000	1. 39	113, 669	20 34	3, 213, 720
Total.....	....	....	3, 611, 446	....	55, 198, 300
WEST VIRGINIA.					
Indian corn.....bushels..	8, 100, 000	27. 8	291, 366	$0 79	$6, 399, 000
Wheat.....do....	2, 562, 000	11. 7	218, 974	1 26	3, 228, 120
Rye.....do....	94, 000	12. 9	7, 286	90	84, 600
Oats.....do....	2, 100, 000	25. 2	83, 333	46	966, 000
Barley.....do....	62, 000	16. 7	3, 712	1 06	65, 720
Buckwheat.....do....	300, 000	14. 2	21, 126	93	279, 000
Potatoes.....do....	850, 000	82	10, 365	57	484, 500

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
WEST VIRGINIA—Continued.					
Tobacco .... pounds..	2, 250, 000	707	3, 182	$0 13	$292, 500
Hay .... tons..	150, 000	1. 44	104, 166	11 17	1, 675, 500
Total	....	....	743, 510	....	13, 474, 940
KENTUCKY.					
Indian corn .... bushels..	51, 500, 000	25	2, 060, 000	$0 66	$33, 990, 000
Wheat .... do....	5, 500, 000	11	500, 000	1 10	6, 050, 000
Rye .... do....	775, 000	11. 2	69, 196	84	651, 000
Oats .... do....	5, 800, 000	19. 4	298, 969	48	2, 784, 000
Barley .... do....	304, 000	19. 5	15, 589	1 23	373, 920
Buckwheat .... do....	17, 000	14	1, 214	1 00	17, 000
Potatoes .... do....	2, 100, 000	69	30, 434	53	1, 113, 000
Tobacco .... pounds..	40, 000, 000	667	59, 970	09. 1	3, 640, 000
Hay .... tons..	155, 000	1. 31	118, 320	14 66	2, 272, 300
Total	....	....	3, 153, 692	....	50, 891, 220
MISSOURI.					
Indian corn .... bushels..	80, 500, 000	30. 6	2, 630, 718	$0 60	$48, 300, 000
Wheat .... do....	7, 500, 000	14. 1	531, 914	80	6, 000, 000
Rye .... do....	325, 000	16. 9	19, 230	69	224, 250
Oats .... do....	6, 500, 000	33	196, 969	40	2, 600, 000
Barley .... do....	300, 000	23. 1	12, 987	1 12	336, 000
Buckwheat .... do....	75, 000	21. 1	3, 554	81	60, 750
Potatoes .... do....	2, 000, 000	115	17, 391	47	940, 000
Tobacco .... pounds..	18, 500, 000	992	18, 649	10. 6	1, 961, 000
Hay .... tons..	750, 000	1. 77	423, 728	11 17	8, 377, 500
Total	....	....	3, 855, 140	....	68, 799, 500
ILLINOIS.					
Indian corn .... bushels..	121, 500, 000	23. 2	5, 237, 068	$0 57	$69, 255, 000
Wheat .... do....	29, 200, 000	11. 2	2, 607, 142	76	22, 192, 000
Rye .... do....	675, 000	14. 4	46, 875	64	432, 000
Oats .... do....	35, 726, 000	32. 5	1, 099, 261	37	13, 218, 620
Barley .... do....	1, 250, 000	20. 9	59, 808	90	1, 125, 000
Buckwheat .... do....	251, 000	15. 1	16, 622	76	190, 760
Potatoes .... do....	7, 500, 000	103	72, 815	41	3, 075, 000
Tobacco .... pounds..	14, 500, 000	633	22, 906	08. 4	1, 218, 000
Hay .... tons..	2, 800, 000	1. 59	1, 761, 006	9 87	27, 636, 000
Total	....	....	10, 923, 5[illegible]	....	138, 342, 380
INDIANA.					
Indian corn .... bushels..	73, 000, 000	23. 2	3, 146, 551	$0 70	$51, 100, 000
Wheat .... do....	20, 600, 000	14. 4	1, 430, 555	93	19, 158, 000
Rye .... do....	575, 000	15. 5	37, 096	76	437, 000
Oats .... do....	12, 413, 000	29. 5	420, 779	44	5, 461, 720
Barley .... do....	411, 000	22. 9	17, 947	1 03	423, 330
Buckwheat .... do....	303, 000	12. 5	24, 240	83	251, 490
Potatoes .... do....	4, 750, 000	106	44, 811	44	2, 090, 000
Tobacco .... pounds..	7, 000, 000	731	9, 575	09. 6	672, 000
Hay .... tons..	1, 200, 000	1. 49	805, 369	10 52	12, 624, 000
Total	....	....	5, 936, 923	....	92, 217, 540
OHIO.					
Indian corn .... bushels..	68, 250, 000	30. 1	2, 267, 441	$0 72	$49, 140, 000
Wheat .... do....	20, 400, 000	15. 5	1, 316, 129	1 03	21, 012, 000
Rye .... do....	1, 050, 000	14. 8	70, 945	82	861, 000
Oats .... do....	27, 000, 000	33	818, 181	46	12, 420, 000
Barley .... do....	2, 600, 000	25. 5	101, 960	1 02	2, 652, 000

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
OHIO—Continued.					
Buckwheat ....bushels..	882,000	12.5	70,560	$0 91	$802,620
Potatoes ....do....	9,600,000	112	85,714	42	4,032,000
Tobacco ....pounds..	16,000,000	700	22,857	06.2	992,000
Hay ....tons..	2,000,000	1.44	1,388,888	10 90	21,800,000
Total........	....	....	6,142,675	....	113,711,620
MICHIGAN.					
Indian corn ....bushels..	14,100,000	28.9	487,889	$0 74	$10,434,000
Wheat ....do....	16,800,000	15.2	1,105,263	97	16,296,000
Rye ....do....	630,000	16	39,375	75	472,500
Oats ....do....	8,700,000	35.4	245,762	49	4,263,000
Barley ....do....	650,000	24.2	26,859	85	552,500
Buckwheat ....do....	850,000	17.7	48,022	79	671,500
Potatoes ....do....	7,500,000	155	48,387	37	2,775,000
Tobacco ....pounds..	3,500,000	1,000	3,500	20	700,000
Hay ....tons..	1,550,000	1.50	1,033,333	12 80	19,840,000
Total........	....	....	3,038,390	....	56,004,500
WISCONSIN.					
Indian corn ....bushels..	9,500,000	26.4	359,848	$0 65	$6,175,000
Wheat ....do....	24,000,000	15.3	1,568,627	68	16,320,000
Rye ....do....	1,150,000	15	76,666	62	713,000
Oats ....do....	22,500,000	36.2	621,546	40	9,000,000
Barley ....do....	1,500,000	25.9	57,915	80	1,200,000
Buckwheat ....do....	63,000	17.6	3,579	71	44,730
Potatoes ....do....	4,800,000	107	44,859	52	2,496,000
Tobacco ....pounds..	....	....	....	....	....
Hay ....tons..	1,460,000	1.45	1,006,896	10 50	15,330,000
Total........	....	....	3,739,936	....	51,278,730
MINNESOTA.					
Indian corn ....bushels..	5,750,000	29.1	197,594	$0 63	$3,622,500
Wheat ....do....	19,000,000	16.3	1,165,644	59	11,210,000
Rye ....do....	56,000	18.8	2,978	56	31,360
Oats ....do....	12,500,000	37.5	333,333	42	5,250,000
Barley ....do....	820,000	25.7	31,906	64	524,800
Buckwheat ....do....	35,000	18.8	1,861	81	28,350
Potatoes ....do....	3,000,000	112	26,785	72	2,160,000
Tobacco ....pounds..	....	....	....	....	....
Hay ....tons..	523,000	1.55	337,419	8 60	4,497,800
Total........	....	....	2,097,520	....	27,324,810
IOWA.					
Indian corn ....bushels..	78,500,000	33.2	2,364,457	$0 50	$39,250,000
Wheat ....do....	23,500,000	13	1,807,692	52	12,220,000
Rye ....do....	540,000	16.1	33,540	52	280,800
Oats ....do....	19,000,000	37.3	509,383	35	6,650,000
Barley ....do....	1,203,000	26.5	45,396	61	733,830
Buckwheat ....do....	160,000	16.7	9,580	82	131,200
Potatoes ....do....	4,500,000	123	36,585	51	2,295,000
Tobacco ....pounds..	....	....	....	....	....
Hay ....tons..	1,650,000	1.86	887,096	7 70	12,705,000
Total........	....	....	5,693,729	....	74,265,830
KANSAS.					
Indian corn ....bushels..	24,500,000	48.4	506,198	$0 44	$10,780,000
Wheat ....do....	2,800,000	18.5	151,351	79	2,212,000
Rye ....do....	20,000	25.8	775	69	13,800

Table showing the product of each principal crop, &c.—Continued.

Product.	Amount of crop of 1869.	Average yield per acre.	Number of acres in each crop.	Value per bushel, ton, or pound.	Total valuation.
KANSAS—Continued.					
Oats .... bushels..	1.500,000	42.1	35,629	$0 37	$555,000
Barley .... do....	25,000	30.6	816	83	20,750
Buckwheat .... do....	150,000	18.5	8,108	99	148,500
Potatoes .... do....	1,500,000	149.	10,067	46	690,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	250,000	1.75	142,857	5 55	1,387,500
Total	....	....	855,801	....	15,807,550
NEBRASKA.					
Indian corn .... bushels..	6,750,000	42.2	159,952	$0 37	$2,497,500
Wheat .... do....	1,000,000	17.8	56,179	51	510,000
Rye .... do....	12,000	19.4	618	53	6,360
Oats .... do....	1,250,000	41.3	30,266	34	425,000
Barley .... do....	9,000	30.2	298	71	6,390
Buckwheat .... do....	50,000	16.7	2,994	1 22	61,000
Potatoes .... do....	550,000	140	3,928	40	220,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	110,000	1.70	64,705	5 03	553,300
Total	....	....	318.940	....	4,279,550
CALIFORNIA.					
Indian corn .... bushels..	1,305,000	41.4	31,521	$0 90	$1.174,500
Wheat .... do....	20,000,000	18.2	1,098,901	93	18,600,000
Rye .... do....	21,200	31.5	673	1 22	25,846
Oats .... do....	2,000,000	41.8	47,846	62	1,240,000
Barley .... do....	12,285,000	35.3	348,016	65	7,985,250
Buckwheat .... do....	15,000	17	882	80	12,000
Potatoes .... do....	2,400,000	125	19,200	79	1,896,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	470,000	1.55	303,225	12 70	5,969,000
Total	....	....	1,850,264	....	36,902,614
OREGON.					
Indian corn .... bushels..	200,000	35	5,714	$0 80	$160,000
Wheat .... do....	1,750,000	19	92,105	85	1,487,500
Rye .... do....	5,200	30	173	1 00	5,200
Oats .... do....	500,000	42	11,904	55	275,000
Barley .... do....	200,000	35	5,714	60	120,000
Buckwheat .... do....	8,000	18	444	75	6,000
Potatoes .... do....	500,000	130	3,846	60	300,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	75,000	1.60	46,875	8 50	637,500
Total	....	....	166,775	....	2,991,200
NEVADA AND THE TERRITORIES.					
Indian corn .... bushels..	2,000,000	28	71,428	$1 10	$2,200,000
Wheat .... do....	2,500,000	25	100,000	1 50	3,750,000
Rye .... do....	....	....	....	....	....
Oats .... do....	1,800,000	32	56,250	1 00	1,800,000
Barley .... do....	400,000	30	13,333	1 00	400,000
Buckwheat .... do....	....	....	....	....	....
Potatoes .... do....	1,500,000	100	15,000	80	1,200,000
Tobacco .... pounds..	....	....	....	....	....
Hay .... tons..	....	....	....	....	....
Total	....	....	256,011	....	9,350,000

Summary for each State, showing the product, the number of acres, and the value of each crop for 1869.

States.	Indian corn.			Wheat.			Rye.		
	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.
Maine	1,450,000	59,670	$1,841,500	248,000	16,103	$453,840	158,000	8,926	$225,940
New Hampshire	1,400,000	46,666	1,820,000	291,000	16,628	538,350	150,000	10,000	207,000
Vermont	1,475,000	43,382	2,065,000	766,000	42,555	1,202,620	155,000	9,687	224,750
Massachusetts	1,950,000	57,017	2,574,000	167,000	9,277	292,250	462,000	25,108	600,600
Rhode Island	440,000	17,460	563,200	8,600	505	13,760	31,000	2,183	43,400
Connecticut	1,950,000	62,500	2,535,000	75,000	4,285	105,000	837,000	68,048	1,155,060
New York	19,100,000	704,797	19,673,000	9,750,000	609,375	13,357,500	4,748,000	327,448	4,890,440
New Jersey	9,200,000	298,701	8,740,000	1,646,000	99,757	2,205,640	1,500,000	101,351	1,680,000
Pennsylvania	29,500,000	939,490	27,140,000	16,500,000	1,114,864	21,120,000	6,250,000	456,204	6,187,500
Delaware	3,200,000	177,777	2,240,000	830,000	61,481	1,062,400	35,000	5,000	33,950
Maryland	12,300,000	608,910	8,979,000	6,733,000	570,593	8,752,900	482,000	39,186	467,540
Virginia	17,500,000	1,129,032	15,925,000	8,642,000	823,047	10,456,820	800,000	86,021	728,000
North Carolina	17,400,000	1,175,675	17,400,000	3,870,000	460,714	5,921,100	400,000	48,192	460,000
South Carolina	8,100,000	698,275	11,340,000	920,000	139,393	1,922,800	55,000	10,185	92,400
Georgia	27,500,000	2,500,000	33,275,000	2,170,000	293,243	3,580,500	73,000	11,230	110,230
Florida	3,100,000	276,785	4,495,000	1,300	130	2,470	12,500	1,388	18,750
Alabama	30,200,000	2,013,333	34,428,000	930,000	119,230	1,506,600	40,000	5,479	58,800
Mississippi	30,000,000	1,714,285	33,600,000	267,000	29,666	467,250	21,000	2,727	35,700
Louisiana	16,850,000	674,000	18,366,500	50,000	4,347	62,500	21,000	1,909	25,200
Texas	23,000,000	793,103	16,790,000	1,250,000	112,612	2,125,000	103,000	5,953	113,300
Arkansas	25,750,000	919,642	23,690,000	1,170,000	99,152	1,766,700	40,000	3,333	54,000
Tennessee	47,500,000	2,375,000	36,575,000	6,750,000	803,571	7,762,500	226,000	22,600	226,000
West Virginia	8,100,000	291,366	6,399,000	2,562,000	218,974	3,228,120	94,000	7,286	84,600
Kentucky	51,500,000	2,060,000	33,990,000	5,500,000	500,000	6,050,000	775,000	69,196	651,000
Missouri	80,500,000	2,630,718	48,300,000	7,500,000	531,914	6,000,000	325,000	19,230	224,250
Illinois	121,500,000	5,237,068	69,255,000	29,200,000	2,607,142	22,192,000	675,000	46,875	432,000
Indiana	73,000,000	3,146,551	51,100,000	20,600,000	1,430,555	19,158,000	575,000	37,096	437,000
Ohio	68,250,000	2,267,441	49,140,000	20,400,000	1,316,129	21,012,000	1,050,000	70,945	861,000
Michigan	14,100,000	487,889	10,434,000	16,800,000	1,105,263	16,296,000	630,000	39,375	472,500
Wisconsin	9,500,000	359,848	6,175,000	24,000,000	1,568,627	16,320,000	1,150,000	76,666	713,000
Minnesota	5,750,000	197,594	3,622,500	19,000,000	1,165,644	11,210,000	56,000	2,978	31,360
Iowa	78,500,000	2,364,457	39,250,000	23,500,000	1,807,692	12,220,000	540,000	33,540	280,800
Kansas	24,500,000	506,198	10,780,000	2,800,000	151,351	2,212,000	20,000	775	13,800
Nebraska	6,750,000	159,952	2,497,500	1,000,000	56,179	510,000	12,000	618	6,360
California	1,305,000	31,521	1,174,500	20,000,000	1,098,901	18,600,000	21,200	673	25,864
Oregon	200,000	5,714	160,000	1,750,000	92,105	1,487,500	5,200	173	5,200
Nevada and the Territories	2,000,000	71,428	2,200,000	2,500,000	100,000	3,750,000	....	....	....
Total	874,320,000	37,103,245	658,532,700	260,146,900	19,181,004	244,924,120	22,527,900	1,657,584	21,877,294

Summary for each State, showing the product, the number of acres, and the value of each crop for 1869—Continued.

STATES.	OATS.			BARLEY.			BUCKWHEAT.		
	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.	Bushels.	Acres.	Value of crop.
Maine	3,200,000	104,918	$2,176,000	750,000	36,231	$855,000	350,000	16,203	$290,500
New Hampshire	1,663,000	55,433	1,147,470	106,000	3,925	111,300	90,000	4,000	73,800
Vermont	5,050,000	141,853	3,383,500	102,000	4,473	136,680	231,000	11,213	198,660
Massachusetts	1,525,000	49,193	1,113,250	144,000	5,760	224,640	85,000	7,391	90,100
Rhode Island	250,000	8,064	177,500	55,000	2,391	70,400	3,100	296	3,565
Connecticut	2,100,000	62,314	1,533,000	25,000	1,086	22,500	270,000	16,666	329,400
New York	31,250,000	892,857	17,500,000	4,600,000	190,871	4,554,000	5,590,000	278,109	4,897,400
New Jersey	6,440,000	188,856	3,670,800	26,000	1,083	26,000	890,000	62,676	1,005,700
Pennsylvania	48,000,000	1,344,537	22,500,000	631,000	26,737	643,620	6,500,000	396,341	6,045,000
Delaware	1,723,000	172,300	775,350	6,000	250	5,400	12,000	923	13,200
Maryland	7,100,000	358,585	3,621,000	24,000	1,043	21,600	150,000	13,157	165,000
Virginia	9,017,600	527,300	4,328,160	28,000	1,618	24,360	75,000	7,009	65,250
North Carolina	3,500,000	231,788	2,275,000	3,500	205	3,500	17,000	562	12,070
South Carolina	850,000	78,703	807,500	7,400	925	14,060	....	....	....
Georgia	1,200,000	97,560	1,140,000	12,300	891	22,509	....	....	....
Florida	23,000	1,769	31,510	4,000	285	7,200	....	....	....
Alabama	567,000	45,000	515,970	9,000	769	16,290	....	....	....
Mississippi	200,000	8,433	196,000	8,000	727	11,200	....	....	....
Louisiana	87,000	6,692	100,050	....	....	....	....	....	....
Texas	1,250,000	44,014	875,000	60,000	2,255	62,400	....	....	....
Arkansas	550,000	22,267	412,500	4,000	297	4,400	....	....	....
Tennessee	3,500,000	209,580	2,100,000	23,000	1,707	31,360	9,000	1,451	9,720
West Virginia	2,100,000	83,333	966,000	62,000	3,712	65,720	300,000	21,126	279,000
Kentucky	5,800,000	298,969	2,784,000	304,000	15,589	373,920	17,000	1,214	17,000
Missouri	6,500,000	196,969	2,600,000	300,000	12,987	336,000	75,000	3,554	60,750
Illinois	35,726,000	1,099,261	13,218,620	1,250,000	59,898	1,125,000	251,000	16,622	190,760
Indiana	12,413,000	420,779	5,461,720	411,000	17,947	423,330	303,000	24,240	251,490
Ohio	27,000,000	818,181	12,420,000	2,600,000	101,960	2,652,000	882,000	70,560	602,620
Michigan	8,700,000	245,762	4,263,000	650,000	26,859	552,500	850,000	48,022	671,500
Wisconsin	22,500,000	621,546	9,000,000	1,500,000	57,915	1,200,000	63,000	3,579	44,730
Minnesota	12,500,000	333,333	5,250,000	820,000	31,906	524,800	35,000	1,861	28,350
Iowa	19,000,000	509,383	6,650,000	1,203,000	45,396	733,830	160,000	9,580	131,200
Kansas	1,500,000	35,629	555,000	25,000	816	20,750	150,000	8,108	148,500
Nebraska	1,250,000	30,266	425,000	9,000	298	6,390	50,000	2,994	61,000
California	2,000,000	47,846	1,240,000	12,285,000	348,016	7,985,250	15,000	882	12,000
Oregon	500,000	11,904	275,000	200,000	5,714	120,000	8,000	444	6,000
Nevada and the Territories	1,800,000	56,250	1,800,000	400,000	13,333	400,000	....	....	....
Total	288,334,000	9,461,441	137,347,900	28,652,200	1,025,795	23,387,909	17,431,100	1,028,693	15,814,265

Summary for each State, showing the product, the number of acres, and the value of each crop for 1869—Continued.

STATES.	POTATOES.			TOBACCO.			HAY.		
	Bushels.	Acres.	Value of crop.	Pounds.	Acres.	Value of crop.	Tons.	Acres.	Value of crop.
Maine	7, 500, 000	58, 593	$3, 900, 000				1, 050, 000	1, 153, 846	$16, 012, 500
New Hampshire	4, 500, 000	30, 000	2, 025, 000				700, 000	660, 377	10, 500, 000
Vermont	5, 750, 000	35, 937	2, 185, 000				1, 100, 000	956, 521	14, 300, 000
Massachusetts	4, 300, 000	40, 566	2, 924, 000	5, 200, 000	4, 333	$1, 352, 000	850, 000	858, 585	20, 757, 000
Rhode Island	770, 000	7, 857	523, 600				71, 000	65, 137	1, 544, 250
Connecticut	2, 500, 000	23, 148	1, 575, 000	6, 500, 000	4, 482	1, 755, 000	750, 000	524, 475	13, 500, 000
New York	28, 500, 000	250, 000	14, 535, 000	8, 500, 000	10, 625	1, 190, 000	4, 600, 000	2, 987, 012	58, 236, 000
New Jersey	5, 300, 000	56, 989	3, 286, 000	100, 000	76	27, 000	525, 000	350, 000	10, 605, 000
Pennsylvania	15, 400, 000	150, 980	9, 240, 000				2, 570, 000	1, 822, 695	38, 164, 500
Delaware	200, 000	2, 857	130, 000				30, 000	26, 086	600, 000
Maryland	1, 050, 000	14, 383	672, 000	14, 500, 000	29, 000	1, 928, 500	191, 000	164, 655	3, 428, 450
Virginia	1, 188, 000	23, 700	819, 720	65, 000, 000	155, 502	6, 695, 000	220, 000	150, 684	3, 390, 200
North Carolina	675, 000	9, 121	540, 000	33, 500, 000	65, 944	4, 589, 500	160, 000	111, 111	1, 937, 600
South Carolina	117, 000	1, 950	155, 610				58, 000	46, 400	1, 353, 140
Georgia	248, 000	4, 065	347, 200	1, 000, 000	2, 666	194, 000	48, 000	32, 876	1, 029, 600
Florida	30, 000	400	51, 000	500, 000	1, 000	145, 000	13, 000	10, 400	260, 000
Alabama	312, 000	4, 952	561, 600				68, 000	49, 635	1, 785, 000
Mississippi	400, 000	4, 494	436, 000				40, 000	34, 482	773, 200
Louisiana	350, 000	3, 888	262, 500				37, 000	24, 666	444, 000
Texas	400, 000	3, 571	640, 000				28, 000	16, 568	397, 040
Arkansas	346, 000	4, 552	346, 000	2, 225, 000	2, 966	304, 825	10, 000	7, 518	126, 000
Tennessee	1, 000, 000	20, 000	730, 000	35, 000, 000	63, 868	4, 550, 000	158, 000	113, 669	3, 213, 720
West Virginia	850, 000	10, 365	484, 500	2, 250, 000	3, 182	292, 500	150, 000	104, 166	1, 675, 500
Kentucky	2, 100, 000	30, 434	1, 113, 000	40, 000, 000	59, 970	3, 640, 000	155, 000	118, 320	2, 272, 300
Missouri	2, 000, 000	17, 391	940, 000	18, 500, 000	18, 049	1, 961, 000	750, 000	423, 728	8, 377, 500
Illinois	7, 500, 000	72, 815	3, 075, 000	14, 500, 000	22, 906	1, 218, 000	2, 800, 000	1, 761, 006	27, 636, 000
Indiana	4, 750, 000	44, 811	2, 090, 000	7, 000, 000	9, 575	672, 000	1, 200, 000	805, 369	12, 624, 000
Ohio	9, 600, 000	85, 714	4, 032, 000	16, 000, 000	22, 857	992, 000	2, 000, 000	1, 388, 888	21, 800, 000
Michigan	7, 500, 000	48, 387	2, 775, 000	3, 500, 000	3, 500	700, 000	1, 550, 000	1, 033, 333	19, 840, 000
Wisconsin	4, 800, 000	44, 859	2, 496, 000				1, 460, 000	1, 006, 896	15, 330, 000
Minnesota	3, 000, 000	26, 785	2, 160, 000				523, 000	337, 419	4, 497, 800
Iowa	4, 500, 000	36, 585	2, 295, 000				1, 650, 000	887, 096	12, 705, 000
Kansas	1, 500, 000	10, 067	690, 000				250, 000	142, 857	1, 387, 500
Nebraska	550, 000	3, 928	220, 000				110, 000	64, 705	553, 300
California	2, 400, 000	19, 200	1, 896, 000				470, 000	303, 225	5, 969, 000
Oregon	500, 000	3, 846	300, 000				75, 000	46, 875	637, 500
Nevada and the Territories	1, 500, 000	15, 000	1, 200, 000						
Total	133, 886, 000	1, 222, 250	71, 651, 730	273, 775, 000	481, 101	32, 206, 325	26, 420, 000	18, 591, 281	337, 602, 600

A general summary showing the estimated quantities, number of acres, and aggregate value of the principal crops of the farm in 1869.

Products.	Number of bushels.	Number of acres.	Value.
Indian corn	874, 320, 000	37, 103, 245	$658, 532, 700
Wheat	260, 146, 900	19, 181, 004	244, 924, 120
Rye	22, 527, 900	1, 657, 584	21, 877, 294
Oats	288, 334, 000	9, 461, 441	137, 347, 900
Barley	28, 652, 200	1, 025, 795	23, 387, 909
Buckwheat	17, 431, 100	1, 028, 693	15, 814, 265
Potatoes	133, 886, 000	1, 222, 250	71, 651, 730
Total	1, 625, 298, 100	70, 680, 012	1, 173, 535, 918
Tobacco ... pounds.	273, 775, 000	481, 101	32, 206, 325
Hay ... tons.	26, 420, 000	18, 591, 281	337, 662, 600
Cotton ... bales.	3, 000, 000	7, 750, 000	303, 600, 000
Total	....	97, 502, 394	$1, 847, 004, 843

Table showing the average yield and cash value and price per bushel, ton, or pound of farm products for the year 1869.

Products.	Average yield per acre.	Average price per bushel.	Average value per acre.	Products.	Average yield per acre.	Average price per bushel, ton, or pound.	Average value per acre.
Indian corn..bushels	23. 5+	$0 75. 3+	$17 74	Buckwheat.bushels	16. 9+	$0 90. 7+	$15 37
Wheat..........do	13. 5+	94. 1+	12 76	Potatoes.......do	109. 5+	53. 5+	58 62
Rye..........do	13. 5+	97. 1+	13 19	Tobacco....pounds.	569 +	11. 7+	66 94
Oats..........do	30. 4+	47. 6+	14 51	Hay..........tons.	1. 42+	12 78 +	18 16
Barley..........do	27. 9+	81. 6+	22 79	Cotton.....pounds.	178 +	22	39 17

Table showing the average yield of farm products per acre for the year 1869.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buck-wheat.	Potatoes.	Tobacco.	Hay.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Pounds.*	*Tons.*
Maine	24. 3	15. 4	17. 7	30. 5	20. 7	21. 6	123	....	. 91
New Hampshire	30	17. 5	15	30	27	22. 5	150	....	1. 05
Vermont	34	18	16	35. 6	22. 8	20. 6	160	....	1. 15
Massachusetts	34. 2	18	18. 4	31	25	11. 5	106	1, 200	. 99
Rhode Island	25. 2	17	14. 2	31	23	15	98	....	1. 09
Connecticut	31. 2	17. 5	12. 3	33. 7	23	16. 2	108	1, 450	1. 43
New York	27. 1	16	14. 5	35	24. 1	20. 1	114	800	1. 54
New Jersey	30. 8	16. 5	14. 8	34. 1	24	14. 2	93	1, 300	1. 50
Pennsylvania	31. 4	14. 8	13. 7	35. 7	23. 6	16. 4	102	....	1. 41
Delaware	18	13. 5	7	19	24	13	70	....	1. 15
Maryland	20. 2	11. 8	12. 3	19. 8	23	11. 4	73	500	1. 16
Virginia	15. 5	10. 5	9. 3	17. 1	17. 3	10. 7	50	418	1. 46
North Carolina	14. 8	8. 4	8. 3	15. 1	17	30. 2	74	508	1. 44
South Carolina	11. 6	6. 6	5. 4	19. 8	8	....	50	....	1. 25
Georgia	11	7. 4	6. 5	12. 3	13. 8	....	61	375	1. 46
Florida	11. 2	10	9	13	14	....	75	500	1. 25
Alabama	15	7. 8	7. 3	12. 6	11. 7	....	63	....	1. 87
Mississippi	17. 5	9	7. 7	23. 7	11	....	89	....	1. 16
Louisiana	25	11. 5	11	13	....	....	90	....	1. 50
Texas	29	11. 1	17. 3	28. 4	26. 6	....	112	....	1. 69
Arkansas	28	11. 8	12	24. 7	13	....	76	750	1. 33
Tennessee	20	8. 4	10	16. 7	16. 4	6. 2	50	548	1. 39
West Virginia	27. 8	11. 7	12. 9	25. 2	16. 7	14. 2	82	707	1. 44
Kentucky	25	11	11. 2	19. 4	19. 5	14	69	667	1. 31
Missouri	30. 6	14. 1	16. 9	33	23. 1	21. 1	115	992	1. 77
Illinois	23. 2	11. 2	14. 4	32. 5	20. 9	15. 1	103	633	1. 59
Indiana	23. 2	14. 4	15. 5	29. 5	22. 9	12. 5	106	731	1. 49
Ohio	30. 1	15. 5	14. 8	33	25. 5	12. 5	112	700	1. 44
Michigan	28. 9	15. 2	16	35. 4	24. 2	17. 7	155	1, 000	1. 50
Wisconsin	26. 4	15. 3	15	36. 2	25. 9	17. 6	107	....	1. 45
Minnesota	29. 1	16. 3	18. 8	37. 5	25. 7	18. 8	112	....	1. 55
Iowa	33. 2	13	16. 1	37. 3	26. 5	16. 7	123	....	1. 86
Kansas	48. 4	18. 5	25. 8	42. 1	30. 6	18. 5	149	....	1. 75
Nebraska	42. 2	17. 8	19. 4	41. 3	30. 2	16. 7	140	....	1. 70
California	41. 4	18. 2	31. 5	41. 8	35. 3	17	125	....	1. 55
Oregon	35	19	30	42	35	18	130	....	1. 60
Nevada and the Territories	28	25	....	32	30	....	100	....	......

Table showing the average cash value of farm products per acre for the year 1869.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buck-wheat.	Potatoes.	Tobacco.	Hay.
Maine	$30 86	$28 18	$25 31	$20 74	$23 59	$17 92	$66 56	....	$13 87
New Hampshire	39 09	32 37	20 70	20 70	28 35	18 45	67 59	....	15 99
Vermont	47 60	28 26	23 20	23 85	30 55	17 71	60 80	....	14 95
Massachusetts	45 14	31 50	23 92	22 63	39 00	12 19	72 08	$312 00	24 17
Rhode Island	32 25	27 20	19 88	22 01	29 44	17 25	66 64	....	23 70
Connecticut	40 56	24 50	16 97	24 60	29 70	19 76	68 64	391 50	25 74
New York	27 91	21 92	14 93	19 60	23 85	17 28	53 14	112 00	19 49
New Jersey	29 26	22 11	16 57	19 43	24 60	16 04	57 63	351 00	30 30
Pennsylvania	28 88	18 94	13 56	16 77	24 07	15 25	61 29	....	29 93
Delaware	12 60	17 23	6 79	4 50	24 60	14 30	45 50	....	23 09
Maryland	14 74	15 34	11 93	10 09	20 70	12 54	46 72	66 50	20 82
Virginia	14 10	12 70	8 46	8 20	15 65	9 30	34 50	43 65	22 49
North Carolina	14 80	12 85	9 54	9 81	17 09	21 41	59 20	69 59	17 43
South Carolina	16 24	13 79	9 07	10 26	15 20	....	71 80	....	29 16
Georgia	13 31	12 21	9 81	11 68	25 25	....	85 49	72 75	31 31
Florida	16 24	19 00	13 50	17 81	25 20	....	127 50	115 00	25 00
Alabama	17 10	12 63	10 73	11 46	21 17	....	115 40	....	35 96
Mississippi	19 60	15 75	13 09	23 22	15 40	....	97 61	....	22 42
Louisiana	27 25	14 37	13 20	14 95	....	....	67 50	....	18 00
Texas	21 17	18 87	19 03	19 83	27 66	....	179 20	....	23 86
Arkansas	25 76	17 81	16 20	18 52	14 30	....	75 00	102 75	16 75
Tennessee	15 40	9 66	10 00	10 02	18 36	6 69	36 50	71 24	28 27
West Virginia	21 96	14 74	11 61	11 59	17 70	13 20	46 74	91 91	16 08
Kentucky	16 50	12 10	9 40	9 31	23 98	14 00	36 57	60 69	19 20
Missouri	18 36	11 28	11 66	13 29	25 87	17 09	54 05	105 15	19 77
Illinois	13 22	8 51	9 21	12 02	18 81	11 47	42 23	53 17	15 69
Indiana	16 21	13 39	11 78	12 98	23 58	10 37	46 64	70 17	15 67
Ohio	21 67	15 96	12 13	15 18	26 01	11 37	47 04	43 49	15 69
Michigan	21 38	14 74	12 00	17 34	20 57	13 98	57 55	290 00	19 20
Wisconsin	17 16	10 40	9 30	14 48	20 72	12 49	75 61	....	15 22
Minnesota	18 33	9 61	10 52	15 75	16 44	15 22	80 64	....	13 33
Iowa	16 60	6 76	8 37	13 05	16 16	13 69	62 73	....	14 32
Kansas	21 29	14 61	17 80	15 57	25 39	18 31	63 54	....	9 71
Nebraska	15 61	9 07	10 28	14 04	21 44	20 37	56 80	....	8 55
California	37 26	16 92	38 43	25 91	22 94	13 60	98 75	....	19 68
Oregon	28 00	16 15	30 00	23 10	21 00	13 50	78 00	....	13 60
Nevada and the Territories.	30 80	37 50	....	32 09	30 00	....	80 00	....	....

Total average cash value per acre of the above crops for the year 1869.

States.	Average value per acre.	States.	Average value per acre.
Maine	$17 70	Texas	$21 47
New Hampshire	19 85	Arkansas	25 19
Vermont	19 02	Tennessee	15 28
Massachusetts	28 30	West Virginia	18 12
Rhode Island	28 31	Kentucky	16 13
Connecticut	29 34	Missouri	17 84
New York	22 19	Illinois	12 66
New Jersey	26 94	Indiana	15 53
Pennsylvania	20 96	Ohio	18 51
Delaware	10 88	Michigan	18 43
Maryland	15 57	Wisconsin	13 71
Virginia	14 61	Minnesota	13 02
North Carolina	15 75	Iowa	13 04
South Carolina	16 07	Kansas	18 47
Georgia	13 49	Nebraska	13 41
Florida	17 15	California	19 94
Alabama	17 36	Oregon	17 90
Mississippi	19 78	Nevada and the Territories	36 52
Louisiana	26 91		

NUMBER AND CONDITION OF FARM STOCK.

The past year has been favorable to the health of farm animals, in its climate, its abundant pasturage, and in its overflowing supplies of hay and grain. The reduction in the price of wheat and other crops, while the rates for pork, beef, and other animal products have been fully sustained, has strongly diverted attention to the increase of live stock, with the single exception of sheep. This increase has been large in the wheat-growing States, particularly marked in the younger of them, as Minnesota, Kansas and Nebraska. It is a hopeful movement, tending to arrest the depletion of the soil by exhaustive cropping, and inaugurating such restorative agencies as clover-growing, green-manuring, fertilizing, and something like systematic rotation of crops.

Farm animals were in excellent condition during the summer, the pastures and ranges being green with succulent grasses, except for a portion of the summer on the southern portion of the Atlantic coast, and in southern California. A deterioration in the quality of pasturage and hay resulted from the excessive rain of spring and early summer in some of the western States, and occasioned a comparatively low condition of stock in winter.

The cattle of the more northern States, in their winter quarters, have been in higher condition than those of the central and southern belts, simply because they are better protected from exposure and better fed. No cattle in the country are in a more healthy condition than those of Maine and of Minnesota; and those of New Hampshire, Vermont, Michigan, and Wisconsin are unsurpassed in that respect by those of any State south of them. They are not only sheltered, cared for, and fed with regularity, but the uniformity of the winter is a stimulant to appetite and conducive to health. In the latitude of the Ohio valley, cold and warm seasons, snow storms and thaws, ice and mud, are endured in turn, and cattle that are ordinarily very comfortable in the open fields or in the lee of a straw stack, are left to stand in pools and mire, or to buffet storms of sleet and biting cold for many days in every winter. Further south, where the friendly forest furnishes the usual protection, and the green cane-brake both food and shelter, cattle are left entirely to the resources of natural production and to the mercy of the elements. The result is, in exceptional seasons, and with a surplus of pasturage, fine condition; but, as a rule, owing to deficient forage at some portion of the winter, or to a cold storm of rain and sleet, or a protracted norther, suffering is experienced, the flesh reduced, and vitality impaired. In proportion as nature is kind, man thus becomes cruel; if his kindly services may, in part, be dispensed with, he becomes totally negligent, and inflicts upon his own pocket losses proportionate to the measure of his own inhumanity and to the sufferings of the dumb creatures that minister to his wants.

Occasionally cattle come through the winter in fair condition, where left to their own instincts of self-preservation and such forage as the season affords. The instances of loss from exposure or starvation, or both combined, are sufficiently numerous, however, to excite pity for the suffering brutes and indignation against the brutal avarice which occasions the suffering. These losses can usually be avoided, although in some cases they may occur despite the utmost care and foresight of the farmer or breeder. A severe and protracted drought in southern California caused the death of thousands. One proprietor in San Luis Obispo County sent off nine thousand to the foot hills of the Sierra Nevadas to preserve them from starvation. The conditions of pasturage

in this section are peculiar. "Part of the dry season, from August to the middle of November," says a correspondent in Stanislaus County, "is the most trying on stock, horses, cattle, and sheep. After rain has fallen and destroyed the nutritiveness of the dry grass is the worst time; then stock sometimes suffer; or when rain holds off till very late, as was the case during the latter part of 1869. No loss was suffered in this county, but in the counties from one hundred to two hundred miles south, perhaps, one-tenth, of both cattle and sheep died from want of water and feed. Cattle, in some instances, were sold for $5 per head, and sheep for 50 cents." One man, in Dakota County, Nebraska, tried to winter two hundred Texas cattle, and lost one-fourth of the number, with a prospect of further losses before the coming of grass in the spring. "Cattle meagerly fed," according to the statement of our local correspondent, "either perished in the two great storms, or are in a fair way to die soon." One-third of a lot of Texas cattle died in Iroquois County, Illinois. Losses from debility and starvation have been less than in former years, mainly from the greater abundance of feed and a milder winter, and in some degree from a better provision for the winter wants of cattle. "Farmers are beginning to see," says a Kansas correspondent, "that it does not *pay* to allow a steer to lose two hundred pounds in winter by want of food and shelter."

DISEASES OF CATTLE.

No prevalent disease has swept away the cattle of any portion of the country during the past year. Isolated cases of mortality occur from a multitude of causes, many of them arising from palpable neglect.

Abortion.—A few cases of abortion are reported in Hillsborough County, New Hampshire; in Essex and Berkshire, Massachusetts; in Otsego, Herkimer, Ontario, Westchester, Tompkins, and other counties in New York. Isolated cases have occurred throughout the West.

The second report of the commission appointed by the New York State Agricultural Society for the investigation of abortion in cows, issued by the society, concludes with the statement of the following affirmative results reached by the commission:

First. That cows which have first calved at under three years of age are more liable to abort during their subsequent pregnancies than those which first calved at three years of age or over, in the proportion of five to three; and that eighty-three per cent. of the cows raised on the farms reporting them do first calve at under three years of age.

Second. That cows subjected to removals at any time are liable to abort over those raised on the farms in the proportion of seven to four and one-half, and that sixty-three per cent. are thus removed.

Third. That cows subject to removals during pregnancy are liable to abort over those moved while not pregnant in proportion to nine to two, and that seventy per cent. of those moved yearly are pregnant, and seventeen per cent. are moved yearly.

Fourth. That arrest of development is the condition immediately preceding abortion; that an excessive drain upon the secretion of milk during pregnancy has a tendency to produce arrest of development in the fetus from inanition; and that an excess of seventy per cent. of milk is demanded from the cows in this district where abortions prevail.

Pleuro-pneumonia has been the cause of much loss and anxiety in Chester County, Pennsylvania; near Chadd's Ford; on the Octoraro; in Beaver County, Pennsylvania, and in Baltimore, Maryland. Some disease, assumed to be pleuro-pneumonia, is reported in Larimer, Colorado. In Washington County, Iowa, a large number of milch cows have been diseased, and ten deaths are reported from "a fever resembling pneumonia."

Blackleg is one of the most general of the diseases affecting our cattle. A few cases occur in many localities where its existence is not indicated

by our returns. It attacks calves and young cattle mainly after leaving winter feed for pasturage. Reports of its ravages come from Riley County, Kansas; from Jackson, Pocahontas, and Bremer, Iowa; Meeker and Mille Lacs, Minnesota; Larimer, Colorado; and from Perry, Pennsylvania.

Charbon, so severe for several years past in the South, has abated; isolated cases are reported in Tangapaho, Louisiana.

Milk fever has caused some loss in Livingston, Michigan, and in Lorain, Ohio.

Diseases locally known as "murrain," "dry murrain," "bloody murrain," and "staggers," have prevailed to some extent in different parts of the South; but the symptoms are not given with sufficient clearness to enable one to tell the proper name of the disease. In Amite County, Mississippi, a disease among cattle has been fatal, commencing with a swelling of the throat. The correspondent of Greene, New York, says: "There have, to a limited extent, been a few cases, in the northern towns of this county, of what some call "cow pox;" it consists in the swelling of the limbs, terminates in sores, and often extends to the udder and body. Yielding readily to a few doses of sulphur, with the application of dilute carbolic acid, but few cases are fatal."

Splenic (or Spanish) fever.—The passage of laws to prevent the summer driving of southern cattle, and their strict enforcement, have limited the losses from this disease in a marked degree. A few cases are reported. One in Chester County, Pennsylvania, furnishes another illustration of the invariable and peculiar features of this disease. Last summer a lot of cattle from North Carolina stopped at Avondale. Soon after they left, other cattle turned into the meadow they had occupied became sick. Some twenty were attacked, and about three-fourths of them died. No other cattle were turned into the same inclosure, and the disease did not spread further. Many believed the ticks which infested the North Carolina cattle, and were communicated to the natives attacked, caused the disease. There is no evidence that these parasites have anything to do with its diffusion or virulence.

The people of Missouri have learned how to prevent the ravages of this insidious disease. The correspondent of St. Louis County, Missouri, says: "We had no Spanish fever last year, Texas cattle being effectually excluded by the provisions of our law during the season they would be likely to spread contagion." The Benton County correspondent reports that "there has been no loss by Spanish fever. The vigilance of the people, and stringent legal enactments, have prevented the introduction or the transit of Texas cattle through this county." From Vernon: "Owing to the stringent laws of this State, but one small drove of cattle direct from Texas succeeded in entering and passing through this county last summer. This drove passed hastily along the east border of this county a short distance, through a district sparsely settled and containing but few cattle for home use. The Spanish fever broke out about six weeks after their passage, and continued until two or three white frosts in October, when it ceased to spread, and those with fever at the time mostly recovered. About forty-four per cent. of the cattle which grazed on the grounds this drove passed over had the fever, two-thirds of which died, the remainder slowly recovering. No other drove is reported as having entered the county till after frost had killed the vegetation. Many thousands then passed through, without a known case of fever." The Bates County correspondent says: "There has been no Spanish fever. The inhabitants of the county are organized, and will not allow cattle to be

driven through, although the laws of the State allow them to come in from December to April. I have known of two herds being driven over in the winter—one in 1867, the other in 1869—and in both instances many of the native cattle which came in contact with them died of the disease a short time after the grass became a full bite." This instance appears to invalidate the certainty of exemption from infection received through stock introduced from the South in winter. The Missouri law was well enforced; but a few droves went through Greene and Cedar, communicating the disease, which resulted fatally.

Last summer tens of thousands of Texas cattle were driven into the southwestern part of Butler County, Kansas. There were but few domestic cattle in that locality, but they all died. There have been several herds of Texas cattle brought direct during the past winter from Texas and the Indian Territory, and pastured and fed in Jefferson County, Kansas, among some of which were occasional losses, but none could be clearly charged to Spanish fever. Our correspondent says: "I have wintered (1869) a herd in my pasture, in which afterward my Durham cattle fed, and no harm has been witnessed." In Franklin, Kansas, the splenic fever appeared about the 1st of September. About one hundred head of native cattle died, mostly cows. The infection was taken from a drove of Texas cattle passing through the county. It is reported from Shawnee, in the same State, that the disease has not prevailed since the shipment exclusively of Texas cattle by rail from Abilene. A few cases are reported in Washington County, Nebraska.

In St. Francis, Arkansas, there has been some Spanish fever, caused by suffering native stock to be penned in lots used by Texas cattle passing through the county.

A lot of Texas cattle brought into Washington County, Virginia, communicated disease to the native stock, resulting in one hundred and fifty deaths.

While it is admitted that southern cattle, particularly cattle in Texas, are apparently healthy, it is undeniable that when driven north without external evidences of disease, the cattle communicating with them are almost invariably attacked upon reaching a certain climatic belt, and during a certain period of time thereafter, with a very fatal fever. At the same time it may be true that this fever gets credit for more than its share of loss. The correspondent in Cherokee County, Kansas, speaks warmly on this subject, as follows:

Everything of which an animal dies is here called Texas fever. Texas cattle are able to run all over the country, with no salt, care or attention, and drink stagnant or slough water heated red-hot in the boiling summer sun; water that is full of leeches and living trash, and without shade on the treeless prairies. People turn out good stock and expect them to thrive like Texas cattle, and when they die they call it Texas fever. There have been cases of Texas fever, but it has killed only a small part of the stock that have died. I deem the principal cause of cattle disease the prevalent neglect of cattle in summer, and failure to furnish hay and shelter in winter, though there is a large area belonging to non-residents from which two tons per acre might be cut.

DISEASES OF HORSES.

It is gratifying to note less of prevalent or contagious disease among horses than has been reported in previous years.

More or less fatality from lung fever has existed in the following counties: Oxford and Penobscot, Maine; Orleans, Vermont; Hunterdon, New Jersey; Adams, Pennsylvania; Kent, Maryland; Huron, Ohio; Story, and Hancock, Iowa.

Glanders is reported in the following localities: Beaver, Pennsylvania; Patrick, Virginia; Perry, Alabama; East Feliciana and Pla-

quemines, Louisiana; Newton, Arkansas; Matagorda, Texas; Sumner, Tennessee; Hall, Nebraska. Some disease resembling glanders is noted in Monroe, West Virginia; Ingham, Michigan; and Merrick, Nebraska. The following extract refers to a similar disease in Atchison, Kansas:

Several horses and mules have been affected with a disease seemingly incurable. The symptoms are a running from the nostrils of a white matter, with some cough, which at times is worse than others; debility without much fever; it is contagious, and defies all remedies known by veterinary practitioners. It seems to be akin to the glanders, but still is not that disease. Killing the animal has been recommended by good judges.

Diptheria has prevailed in Chester, Pennsylvania, and Fayette, Kentucky.

Colic is more or less common, but is not so extensively fatal as to require special report. Many losses have occurred in Luzerne, Pennsylvania, from colic and ill-treatment, and in the same county twenty horses died in a mine from some unknown cause. Colic, with ill-usage and starvation, has been fatal in Wilkinson, Mississippi. In Burt, Nebraska, some deaths have occurred from colic caused by eating green corn and new oats.

In Washington, New York, swelling and stiffness of the joints, sometimes attended with partial blindness, has been a common complaint.

An affection of the kidneys in Tompkins, New York, has occasioned some loss.

In Clarke, Alabama, horses have been attacked with a swelling under the throat and jaws, extending down the legs, which causes death.

The buffalo fly has caused the death of horses and mules in Lauderdale, Tennessee.

Charbon, so fatal in the South a few years ago, has nearly disappeared; it is less fatal than formerly in places mentioned, as Yazoo and Holmes, Mississippi, and Desha, Arkansas.

In Lac, Iowa, a disease assumed to be chronic inflammation of the liver has been fatal.

"Blind staggers" is reported in many localities throughout the South.

In Alameda, California, influenza and milk fever are reported as prevalent.

In Pulaski, Illinois, horses brought from Kansas communicated a disease to those with which they came in contact, which proved fatal in two or three weeks, while the Kansas horses remain in about the same condition as when introduced.

A large number of horses has been lost by a catarrhal fever at Cleveland, Ohio. A disease affecting the coffin joint, resulting fatally in ten days, has occasioned some loss. Diagnosis shows a separation of the ligaments of the joint and foot, which turns up, causing the animal to step upon the ankle. The flexor tendons are literally severed from the lamina, and the foot will drop off by simply cutting through the skin with a knife. None have ever been cured, and no one appears to know the cause of the difficulty. Animals, apparently healthy, drop in harness or at pasture, get up only a few times, and are unable to walk a step.

The following extracts from correspondence refer to other diseases:

Kalamazoo County, Mich.—A strange disease has prevailed to some extent in this county during the last three months. Nearly all the horses die that are attacked. It does not seem to yield to any remedies, so far as I can learn. It is thought to be contagious, one farmer having lost four within a short time.

Vernon County, Mo.—Horses have died in large excess of former years. The reports show three diseases—blind staggers, yellow water, and sore tongue. They are all described as living about a month before dying; eat hearty, get hide-bound, the hair

deadens, they maturate at the eyes and nose, and die of weakness. Some farmers have lost nearly all their horses in this way. From the information received, I have reduced the three diseases to one, and that one caused by feeding the worm-eaten corn (carelessly) which was so abundant last year, owing to the continued rains.

A fatal disease affecting horses is reported from Douglas County, Nevada:

Post mortem examination determines the cause to be a small wire worm, from one-half an inch to two inches in length, pointed at either end, white, and about the diameter of a cambric needle. They penetrate the body of the animal in all directions, and have been found in some instances between the flesh and the skin. They are hard, wiry, and very tenacious of life. When placed in a decoction of tobacco juice they swim around quite playfully, eventually, however, giving it up. The symptoms manifested by the animal are weakness of the loins and general debility, gradually growing worse, lingering from five to ten days thereafter. The disease is not confined to any locality. One farmer lost eight, his neighbor nine; another lost twenty-six, among which was a valuable stallion that was kept up in the stable; the remainder were running out. Mr. Boles informed me that he saved his last five attacked by administering three ounces of spirits of turpentine and two ounces of sweet oil in one dose, and obliging the animal to eat warm bran mixed with flax-seed. He informs me that one colt passed over two quarts of worms.

In Gloucester County, Virginia, several horses and mules died from the effects of feeding upon moldy oats, which caused paralysis of the lower extremities, and ultimately death.

DISEASES OF SHEEP.

For a few years past scab and foot-rot have been very prevalent among large flocks in New York, Ohio, and several of the Western States. During the past year, owing to the culling and killing of diseased sheep, and greater care and better treatment, these diseases appear to be less prevalent. There is still much foot-rot; in some counties twenty-five per centum of all flocks have it among them, and in a few instances a much larger proportion. These diseases have spread somewhat by the dispersion of flocks to the West and South. Liver-rot is reported in Cuyahoga, Ohio, and rot is mentioned repeatedly in returns without indicating whether foot-rot or liver-rot is meant. Grub in the head appears to be less common than heretofore. A disease of the loins has been fatal in Utah. In Ohio several reports of death from "pale disease" are received. A few cases of dropsy are mentioned. In Texas losses of lambs have been very severe from worms, and some fatality has been caused by exposure during cold weather. It does not appear that a larger percentage than usual of mortality of lambs has been suffered. The following extracts from correspondence are appended:

Tuscarawas County, Ohio.—Sheep diseases are various. The most serious is what is called the pale disease and foot-rot. As to the cause of the pale disease, men differ; one fact is noticeable, that it is mostly confined to lambs and yearlings, and the deaths occurring from time to time, after the first of January. Their skins will be found white and bloodless; reduced in flesh, but not to as great an extent as might be supposed; some have been examined and small worms found in their intestines. It is my impression, derived from observation and practice, that a great deal of the pale disease could be avoided by taking the sheep in to winter in good, strong condition, and the time to watch and observe the sheep the most carefully is soon after the first frosts of autumn appear, and then a little grain fed daily until winter begins will be money well expended.

Fulton County, Ohio.—A disease attacks many while in good condition. They eat sparingly, get weak, and after a week or two die. No remedy has been found. There is no running at the nose, or eyes, nor other indications of a disease of the head.

Winnebago County, Ill.—Last year I made a statement of an unusual disease appearing among my lambs. A similar trouble appeared again this last fall, commencing later in the season and running nearly through the winter, not so fatal as in the fall of 1868; then I lost about one-half of my lambs; during the last fall and winter about one-fifth have died, and, with one exception, of the same cause, dysentery. I have examined quite a number of those that died, and have come to the conclusion that the worms are the primary cause of the disease. I find small white worms by millions all through the intestines, the latter being completely full of knobs, which, if I mistake not, contain

the eggs of the parasites. Some of my sheep died early in the winter of the same cause. Several flocks of lambs were decimated by dysentery last fall in this county.

De Witt County, Ill.—Our sheep have been subject to most all the diseases to which they are liable, the scab and foot-rot being the most prominent and fatal. I think that fully three-fourths of our entire sheep have been carried off by these diseases, or affected to such an extent as to cause the owner to kill them for the pelt, the carcass being fed to hogs.

Laurel County, Ky.—There has been a disease rather unusual among sheep. The animal stands in a very stupid manner; will not eat anything; if driven will move forward without turning for any obstacle, until he runs against it as if he was blind. The eyes are wide open. In this condition he lives eight or ten days and then dies.

Nebraska.—Great mortality from scab is reported from Merrick County. Seventy-five per centum of the sheep have died from scab. One man had three thousand head in the fall; to-day he has about three hundred. I am satisfied his sheep did not get the care they were entitled to—a course of practice, I am sorry to say, too common in this county.

Worth County, Mo.—One flock of about twenty-five, a year ago had a disease new to me and to others in this vicinity. They would commence stepping forward with their fore feet, until their bellies would almost touch the ground, and would stand in that position till they would fall over. The remedy used was a piece of asafœtida, about as large as a small hickory nut, boiled in sweet milk, which proved effectual in most cases, but in case of a second attack they were incurable; at least, all attacked the second time died.

Lewis County, Mo.—There is little disease among the native sheep, but of one flock of eight hundred and fifty imported from Illinois, all died except about six.

Bexar County, Mo.—The scab was unknown until of late years, when it was introduced by sheep brought from other States. The original sheep of the county, the Mexican, were never affected by the scab. It has been found to yield readily to treatment with tobacco juice, with which the scab has to be washed, after the wool has been taken off. One flock numbering eight thousand head in 1861, was reduced to one thousand four hundred by 1868, when they were moved to a fresh range two hundred miles off. They are now recovering.

DISEASES OF SWINE.

Either there is something radically wrong in the management of swine, resulting yearly in the loss of millions of young pigs and hogs, or else the genus *Sus* is an unhealthy and unwholesome animal, and therefore unfit for human food. One or the other of these conclusions seems to be forced upon the common sense and sound judgment of the observer. The mortality among young pigs, for which the butcher has no responsibility, is nearly, if not quite, proportionate to that of infants of the human species, and aggregates millions of individuals yearly. What is the cause? It is greatest in the West, notwithstanding the healthfulness of a free range, while eastern pigs are generally shut up in close pens. In all accounts of "hog cholera," which popularly means any disease which sweeps off the species as an epizoötic, while remedies are unavailing, preventive is found to be practicable, at least in a partial degree, and coal ashes, salt, sulphur, soap, saltpeter, gas lime, coal oil, tar, charcoal, sulphate of iron, smartweed tea, soap-suds, poke-root, tobacco, asafœtida, garget-root, mandrake, and all the poisons of the apothecary shop are administered. There appears to be an irrepressible craving for something besides the inevitable corn, which is too concentrated for the exclusive and continuous diet of any animal, hence those who feed sloppy mashes of potatoes, beets, or other roots, as well as corn, giving wholesome variety and sufficient bulk, and have exercised ordinary care and discretion in other respects, have ordinarily escaped the dreaded "hog cholera." Occasional feeds of bituminous coal, charcoal, sulphur, and similar substances of antiseptic or corrective tendency, have become quite common, and testimony to their efficacy is abundant. Spirits of turpentine, copperas, and arsenic are often given in the way of preventive medication as well as in attempted cure. A judicious variety in feed, and care and treatment dictated by reason and prudence, of which an interest involving so much money is

certainly worthy, would doubtless prevent much the greater portion of the losses which are so disastrous as to prevent farmers from enlarging and even continuing a business which has become so precarious. Numerous reports are received showing the discouragements of pork producers in districts where diseases have been peculiarly fatal, and revealing a disposition to quit hog-raising altogether.

New York.—A few cases of dysentery in Tompkins. Many pigs die in Genesee; in Niagara few sows raise more than three or four.

New Jersey.—Some cases of "hog cholera" among a lot fed upon the refuse of a cheese factory in Sussex. A few Western hogs died in Mercer; loss, $200. Some disease in Gloucester.

Pennsylvania.—In Lancaster one distiller lost one hundred out of three hundred; a miller lost all (thirteen) Western hogs, some worth $30 to $60 each. One-half of a lot of Ohio hogs died in York; loss, five per cent. in Perry, twenty per cent. in Lehigh.

Maryland.—Losses in Washington, Baltimore, and Kent.

Virginia.—Measles prevalent in Princess Anne; loss, thirty-three per cent. in Nelson; loss, two thousand in Henrico, mainly at distilleries. Some feeders in Montgomery lost thirty fat hogs each; loss, thirty-three per cent. in Scott. In Surrey one man lost seventy. In all cases hogs kept up and fed on cooked food escaped.

North Carolina.—Loss in Duplin and Jackson, fifty per cent.; New Hanover, thirty per cent.; Macon, twenty-five per cent.; Caldwell, twenty per cent.; and smaller losses were incurred in Chowan, Beaufort, Surry, Granville, Alamance, and Moore. In Greene several thousand pounds of pork were lost.

South Carolina.—In Union and in Georgetown Counties losses have been serious.

Georgia.—Loss, twenty-five per cent. in Pike, twenty per cent. in Warren and Chattanooga, ten per cent. in Clayton and Gilmer; less in Butts, Stewart, Taylor, and Walton.

Alabama.—Loss, fifty per cent. in Lawrence, twenty-five in St. Clair, ten in Jefferson, and slight loss in Etowah and Tallapoosa.

Mississippi.—Loss, fifty per cent. in De Soto, twenty in Coahoma, and less in other counties.

Arkansas.—Great mortality from measles in Desha. The correspondent for Arkansas County says: "Loss from hog cholera, as near as I can judge, about twenty-five per cent. Since the winter fifty per cent. have died for the want of feed; the mast failed, and the farmers had no corn to feed on, as most of the ground was planted in cotton. Take all together, I think seventy-five to eighty per cent. have died where the disease prevailed." Loss in Mississippi, forty per cent.; in Montgomery, thirty-three per cent.; in Independence and Madison, twenty per cent.; in Jackson, seventeen per cent.

Texas.—In Travis, Fayette, and other counties, a great mortality of young pigs is attributed to their eating young cockle burrs. Large losses of such are reported from Anderson, Coryell, Rusk, and Kaufman.

Tennessee.—Loss fifty per cent. in Anderson, thirty in Dyer, twenty-five in Smith and Lauderdale, $1,000 worth in Union, and considerable in Weakley, Sullivan, Obion, Hawkins, Coffee, Jefferson, Greene, Giles, and Campbell.

Ohio.—Loss less than usual. A little cholera in Butler, Fairfield, Greene, Montgomery, and Wayne.

Kentucky.—Heavy loss is noted in this State. In Shelby, three thousand out of twelve thousand fattening; in Oldham, one thousand head; in Henry to an alarming extent; heavy loss in Rockcastle; fifty per

cent. in Christian and Laurel; twenty-five per cent. in Nelson; considerable in Jefferson, Gallatin, Callaway, Clark, Warren, Lincoln, Kenton, Johnson, and others.

In Michigan hog cholera is reported only in Ottawa, and in Wisconsin only in Waushara.

Indiana.—Hog cholera has been far less prevalent than usual, but the losses range from twenty per cent. downward in Warren, Martin, Dubois, Green, Benton, Pike, Johnson, Carroll, Bartholomew, Scott, Jefferson, Harrison, Miami, and Elkhart. In parts of Tippecanoe the loss is fifty per cent.; fifty per cent. is given in Posey; and in Fayette four-tenths of last year's pigs were lost. The correspondent in Bartholomew says: "Hog cholera has prevailed in some localities, while others have escaped entirely. It may be remarked that the disease known as hog cholera has somewhat spent its force, and is not as fatal as when it first made its appearance among us. Whether this abatement of its force and fatality will continue, and lead to its gradual and final extinction by natural or unknown causes, I cannot say. It is a matter worthy of note, that hogs in large lots and of small range are much more liable to contract the disease than when differently situated."

Johnson County.—The hog cholera prevails more or less every year. I suppose the loss will average at least one-tenth for each season. But the actual loss by deaths caused by the disease is not so much the cause of the decrease of the pork product as the prevalence of cholera among hogs. Farmers are too cautious of their money and labor to put them in animals liable to such a fatal disease. Pork cannot be plenty or cheap until the disappearance of the hog cholera from among hogs.

Illinois.—In De Kalb the loss of two thousand old hogs and one thousand pigs is reported; in Crawford it amounts to $20,000; in Bureau, three hundred hogs; in Edwards and Champaign more loss was noted in rolling districts and in "timber" than in prairie; and other counties in which cholera and other diseases have prevailed are as follows: Piatt, (three hundred in one township,) Monroe, Menard, Rock Island, Macoupin, Logan, Jo Daveiss, Fulton, De Witt, Stephenson, Marion, Mercer, Kendall, Jackson, Henderson, Boone, Gallatin, Morgan, Lee, Greene, Williamson, (twenty-five per cent.,) Fayette, Pike, Massac, Clinton, White, (fifty per cent.,) Stark, Scott, and Pulaski. The following extract illustrates one aspect of the preventive question:

So thoroughly am I convinced of the use of preventives, that for the last three or four years I have been in the habit of feeding my hogs daily with a mixture composed of various ingredients, the basis of which is kitchen slops, to which is added a plentiful supply of salt, bran, Irish potatoes, cabbage, turnips, and other vegetables, all of which I endeavor to raise for that purpose in sufficient quantities. The above are all boiled together and fed when cool in large troughs, to which all the hogs have access. A few years since I lost some hogs with cholera, but since I commenced the above practice I have not lost a single hog with cholera, and but very few with any other disease, although I keep a number varying from twenty to forty head. At the same time my neighbors are continually complaining to me of their losses, and although I explain to them my plan of treatment, and that my hogs don't die of cholera, very few of them seem to profit by my experience. "Well," they reply, "we don't know how it is; we slop our hogs also, *sometimes*, and still they die." Besides slop, I feed my hogs dry corn daily. Whether or not it is the slop which keeps off the cholera I cannot positively say; but I certainly should be afraid to feed them entirely on corn or any other dry food.

Deaths of pigs are common in Minnesota.

Iowa.—In three townships in Mahaska the loss is $5,000. One thousand head in Appanoose. Losses occurred in Louisa, (twenty per cent.,) Clarke, Pottawatomie, Jackson, Warren, Cedar, Page, Butler, and Mills.

Missouri.—The disease is reported in a few counties. The correspondent of Howard says: "Cholera among hogs has prevailed to some extent, but chiefly among the hogs of those who are careless in not

crossing with pure animals of good breeds. Those who are particular in keeping up the stock by crossing Chester, Poland, and Berkshires, have lost very few. With old stock bred in and in, the loss has, in some instances, been very great."

Nebraska.—A few hogs fed upon slops of breweries and still-houses in Douglas have sickened and died. In one case a lot of corn that the government refused to accept was fed to hogs, and considerable mortality resulted.

No mention is made of the hog cholera in California, but the following from Stanislaus County indicates a decrease in pork:

The business of swine-raising is in the hands of a few, and is followed as a distinct one. Those in it keep from two hundred to fifteen hundred or more, herding them in the foot-hills during the rainy season, where roots and mast abound. After grain is cut and threshed, in July and August, on the plains, the owners of the hogs buy the fields for the season, and turn their hogs into them, where they feed until fall, when the fat ones are sold for pork in the best market—usually San Francisco. From the scarcity of mast and roots, the increase in herds was less the past year than formerly. The use of the header in harvesting, in place of the reaper, leaves less grain in the field than in former years; consequently the hogs made less pork this fall than other years. The falling off in the increase of stock and the weight of pork in this county may be placed at two-tenths.

NUMBERS AND PRICES OF FARM ANIMALS.

The numbers given in the accompanying table are estimates derived from all attainable data, and cannot be assumed to be infallibly correct. Indeed, the defects in the census of 1860, (upon which the annual statements are based,) both in the requirements of the law and the fidelity of its execution, render it impossible to guarantee entire accuracy, even with comparative returns which should realize perfection, as ours cannot claim to do. In addition to this difficulty, another appears, of a most serious character, in the violent fluctuation of the increase or of decrease, and in the South the failure of all the statistical correspondence during the entire period of the war. In these estimates are included not only animals found upon farms, but in cities, in markets, and elsewhere. The census schedules of 1860 included only farm animals, and thus, in some instances, (as the item of horses in Massachusetts,) less than half of the actual numbers appear in the regular census tables.

The average cash value is obtained from county estimates, and is, in the judgment of correspondents, based upon the actual selling prices; it is, therefore, much higher than the taxable values as returned by assessors.

Table showing the estimated total number and total value of each kind of live stock, and the average price in February, 1870.

States.	Horses.			Mules.			Oxen and other cattle.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	87,000	$100 94	$8,781,780				215,000	$43 30	$9,300,500
New Hampshire	48,500	83 86	4,067,210				145,000	44 26	6,417,700
Vermont	65,000	82 99	5,394,350				165,400	38 11	6,303,394
Massachusetts	105,000	122 60	12,873,000				124,500	49 48	6,160,260
Rhode Island	13,500	98 62	4,331,370				20,500	61 14	1,253,370
Connecticut	55,000	115 17	6,334,350				143,700	61 51	8,838,987
New York	600,000	104 12	62,472,000	6,000	$139 82	$838,920	702,000	45 91	32,228,820
New Jersey	112,500	134 94	15,180,750	14,200	152 87	2,170,754	90,500	47 79	4,324,995
Pennsylvania	501,500	104 41	52,361,615	21,400	130 43	2,791,202	725,000	36 25	26,281,250
Delaware	21,000	94 01	1,974,840	2,900	128 37	372,273	34,500	28 56	985,320
Maryland	98,500	92 20	9,081,700	11,900	123 18	1,465,842	123,400	31 07	3,834,038
Virginia	220,500	89 58	19,752,390	32,400	114 33	3,704,292	295,000	20 42	6,023,900
North Carolina	125,500	92 74	11,638,870	43,600	116 70	5,088,120	295,500	11 15	3,294,825
South Carolina	51,300	117 75	6,040,575	40,700	126 01	5,128,607	167,700	11 58	1,941,966
Georgia	108,500	119 57	12,973,345	85,800	151 58	13,005,564	401,500	11 38	4,569,070
Florida	10,400	123 38	1,283,152	6,300	141 69	892,647	180,500	8 22	1,483,710
Alabama	100,600	107 18	10,782,308	95,900	133 33	12,791,142	335,000	13 74	4,602,900
Mississippi	80,200	110 29	8,845,258	93,500	141 30	13,211,550	327,000	14 34	4,689,180
Louisiana	65,000	116 48	7,571,200	71,300	140 70	10,031,910	183,700	11 34	2,083,158
Texas	622,000	37 53	23,343,660	80,500	51 73	4,164,265	3,500,000	6 10	21,350,000
Arkansas	131,600	87 87	11,563,692	61,200	106 57	6,522,084	201,800	12 02	2,425,636
Tennessee	317,500	90 41	28,705,175	91,000	112 01	10,192,910	319,000	17 26	5,505,940
West Virginia	90,500	78 84	7,135,020	3,000	91 96	275,880	210,000	28 12	5,905,200
Kentucky	321,000	80 40	25,808,400	82,300	89 31	7,350,213	404,500	30 08	12,167,360
Missouri	460,000	64 14	29,504,400	80,200	87 20	6,993,440	703,000	22 26	15,648,780
Illinois	881,500	70 94	62,533,610	93,000	85 63	7,963,590	980,000	25 10	24,598,000
Indiana	555,600	75 04	41,692,224	35,700	82 25	2,936,325	575,000	28 07	16,140,250
Ohio	724,200	80 99	58,652,958	26,000	86 44	2,247,440	752,000	33 99	25,560,480
Michigan	259,000	83 23	21,556,570	4,000	94 45	377,800	370,000	32 77	12,124,900
Wisconsin	275,500	83 33	22,957,415	5,000	113 83	569,150	443,800	26 09	11,578,742
Minnesota	102,500	90 82	9,309,050	2,500	105 53	263,825	204,400	28 29	5,782,476
Iowa	513,900	81 01	41,631,039	32,500	89 39	2,905,175	747,700	25 78	19,275,706
Kansas	125,000	73 31	9,163,750	5,000	86 05	430,250	213,300	27 35	5,833,755
Nebraska	31,500	95 29	3,001,635	1,700	121 78	207,026	113,600	29 77	3,381,872
California	238,000	36 50	8,687,000	30,000	66 66	1,999,800	550,000	26 22	14,421,000
Oregon	70,000	53 34	3,733,800				175,000	22 00	3,850,000
Nevada and the Territories	60,000	60 00	3,600,000	20,000	84 64	1,692,800	250,000	27 00	6,750,000
Total	8,248,800		671,319,461	1,179,500		128,584,796	15,388,500		346,926,440
Grand average of prices		81 38			109 01			22 54	

Table showing the number, price, and value of the live stock, &c.—Continued.

States.	MILCH COWS.			SHEEP.			HOGS.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	170,000	$39 80	$6,766,000	551,000	$2 79	$1,537,290	45,000	$16 46	$740,700
New Hampshire	98,700	43 66	4,309,242	406,500	2 59	1,052,835	41,500	18 72	776,880
Vermont	199,000	50 33	10,015,670	976,000	2 89	2,820,640	43,600	16 62	724,632
Massachusetts	170,000	57 00	9,690,000	156,000	3 28	511,680	63,000	19 35	1,219,050
Rhode Island	24,800	55 00	1,364,000	36,500	4 32	157,680	13,500	15 66	211,410
Connecticut	143,000	60 14	8,600,020	157,800	4 42	697,476	67,600	17 65	1,193,140
New York	1,450,000	54 11	78,459,500	4,350,000	3 04	13,224,000	995,000	12 88	12,815,600
New Jersey	175,000	63 93	11,187,750	175,000	4 41	771,750	203,000	16 07	3,262,210
Pennsylvania	725,000	46 83	33,951,750	2,850,000	2 86	8,151,000	1,014,500	12 61	12,792,845
Delaware	22,000	40 66	894,520	17,500	4 37	76,475	44,900	9 12	409,488
Maryland	99,500	43 18	4,296,410	256,500	4 09	1,049,085	335,000	8 80	2,948,000
Virginia	240,000	30 04	7,209,600	557,000	2 58	1,437,060	904,400	5 42	4,901,848
North Carolina	205,500	20 55	4,223,025	325,000	1 66	539,500	850,000	4 78	4,063,000
South Carolina	140,500	22 63	3,179,515	165,000	1 73	285,450	308,000	4 26	1,312,080
Georgia	250,000	22 48	5,620,000	275,000	1 68	462,000	1,335,500	3 61	4,821,155
Florida	81,000	16 16	1,308,960	10,500	2 00	21,000	104,500	3 12	326,040
Alabama	186,600	23 46	4,377,636	225,000	1 59	357,750	716,500	5 40	3,869,100
Mississippi	175,000	26 34	4,609,500	175,000	1 77	309,750	643,000	5 02	3,227,860
Louisiana	75,000	30 14	2,260,500	75,500	2 00	155,000	170,200	3 04	517,408
Texas	615,000	10 67	6,562,050	1,223,000	1 70	2,079,100	1,004,000	2 67	2,680,680
Arkansas	130,000	22 60	2,938,000	135,000	2 00	270,000	830,400	5 32	4,417,728
Tennessee	222,500	29 07	6,468,075	366,500	1 82	667,030	1,505,000	4 81	7,239,050
West Virginia	101,000	33 60	3,393,600	827,900	1 89	1,564,731	357,000	5 26	1,877,820
Kentucky	225,000	38 51	8,664,750	942,000	2 75	2,590,500	1,955,000	5 91	11,554,050
Missouri	357,000	32 32	11,538,240	1,679,000	1 70	2,854,300	2,300,000	5 79	13,317,000
Illinois	603,000	37 02	22,323,060	1,995,000	1 65	3,291,750	2,005,000	8 15	16,340,750
Indiana	427,000	40 41	17,255,070	2,160,500	1 73	3,737,665	2,025,000	7 91	16,017,750
Ohio	760,000	44 77	34,025,200	6,250,000	1 98	12,375,000	1,700,000	9 40	15,980,000
Michigan	315,000	42 94	13,526,100	3,340,000	1 93	6,446,200	462,000	8 19	3,783,780
Wisconsin	370,000	35 78	13,238,600	1,670,000	2 13	3,557,100	427,000	8 39	3,582,530
Minnesota	135,000	36 11	4,874,850	125,300	2 42	303,226	131,300	7 36	966,368
Iowa	415,500	34 91	14,505,105	2,003,000	1 57	3,144,710	2,500,000	8 07	20,175,000
Kansas	140,700	37 42	5,264,994	120,000	2 11	253,200	516,000	7 05	3,637,800
Nebraska	48,300	39 91	1,927,653	25,000	2 50	62,500	125,000	8 05	1,006,250
California	350,000	47 62	16,667,000	3,750,000	2 56	9,600,000	750,000	4 47	3,352,500
Oregon	90,000	32 00	2,880,000	500,000	1 90	950,000	160,000	3 00	480,000
Nevada and the Territories	160,000	41 03	6,564,800	2,000,000	3 00	6,000,000	100,000	6 50	650,000
Total	10,095,600		394,940,745	40,853,000		93,364,433	26,751,400		187,191,502
Grand average of prices		39 12			2 28			6 99	

LIVE STOCK MARKETS.

NEW YORK.

The receipts of live stock during the year 1869 (ending December 27) were as follows: Beeves, 325,761; milch cows, 4,836; veal calves, 93,984; sheep and lambs, 1,479,563; swine, 901,398. Total, 2,805,452, against the following for 1868: Beeves, 293,101; milch cows, 5,382; veal calves, 82,935; sheep and lambs, 1,400,623; swine, 976,511. Total, 2,758,552.

The sources of supply of beeves were as follows:

Illinois	198,433	Canada	1,741
Ohio	29,792	Pennsylvania	1,351
Texas	23,178	Connecticut	1,090
Kentucky	22,887	West Virginia	935
New York	19,170	New Jersey	869
Indiana	11,077	Florida	275
Missouri	10,596	Massachusetts	52
Michigan	2,281	Tennessee	18
Iowa	2,061	Nebraska	15

PRICES.—The following are quotations for the last market week in each month during the year. Cattle quoted at net weight of quarters; sheep and hogs at live weight.

Months.	Beef cattle.			Sheep.	Hogs.
	Good to prime.	Common to medium.	Average.		
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	16 to 17½	10 to 14¾	15	5 to 8	11 to 11¾
February	15 to 17¼	10 to 14½	14¾	5½ to 8¼	10½ to 11
March	16 to 17	12 to 15½	15½	6 to 9½	10¾ to 11¼
April	16 to 17½	11 to 15	15	6½ to 9½	10¼ to 10¾
May	15¼ to 16¼	12 to 15	15	4½ to 7½	9 to 9½
June	15¼ to 16½	12 to 14½	14¾	4½ to 6½	9¼ to 9¾
July	15 to 16½	10 to 14	14	4½ to 6½	9¾ to 10¼
August	15 to 16½	11 to 14¼	14½	4 to 6	9¼ to 9¾
September	15 to 16	8 to 13½	14	4½ to 6½	9½ to 10½
October	15 to 16½	9 to 14	14	4 to 6¼	9¼ to 9¾
November	15 to 16½	9 to 14	14	4 to 6½	9½ to 10½
December	16½ to 18	11 to 15	14½	4¾ to 8	9½ to 10¼

CHICAGO.

The receipts of live stock during the year were as follows: Cattle, 403,102; hogs, (live and dressed,) 1,852,882; sheep, 340,072.

Monthly receipts of live stock for each month, and monthly prices of cattle and hogs.

Months.	Receipts for each month.			Prices.	
	Cattle.	Hogs.	Sheep.	Cattle.	Live hogs.
	Number.	*Number.*	*Number.*		
January	20,970	206,398	23,970	$3 60 to $7 75	$9 25 to $11 25
February	22,346	104,129	33,840	3 25 to 8 00	10 25 to 12 25
March	37,015	85,598	50,962	3 50 to 8 25	8 50 to 11 00
April	37,172	103,404	43,005	3 50 to 7 75	8 75 to 11 00
May	44,377	129,282	21,939	4 50 to 7 75	8 50 to 10 25
June	43,167	174,460	24,056	5 25 to 7 75	8 00 to 9 30
July	40,661	129,578	15,365	4 00 to 7 75	8 25 to 9 40
August	29,364	131,797	20,578	3 25 to 7 75	8 00 to 10 00
September	37,475	106,090	25,198	3 25 to 8 60	8 25 to 9 90
October	41,891	146,597	37,198	2 75 to 7 25	8 50 to 10 60
November	27,788	260,151	25,250	2 50 to 7 25	7 85 to 10 00
December	20,876	274,907	18,711	2 50 to 7 25	8 40 to 11 60

Receipts and shipments of beef cattle at Chicago for fifteen years.

Year.	Received.	Shipped.	Packers & city butchers.	Year.	Received.	Shipped.	Packers & city butchers.
1855	10,715	8,253	2,462	1863	298,381	203,247	95,134
1856	31,950	22,502	9,448	1864	336,627	179,520	157,107
1857	48,524	25,502	23,022	1865	333,362	242,766	90,596
1858	118,155	44,149	74,006	1866	392,604	262,150	130,454
1859	90,574	35,973	54,601	1867	327,650	213,265	114,385
1860	155,753	104,122	51,631	1868	324,534	215,987	108,547
1861	204,579	124,146	80,433	1869	403,102	294,717	108,385
1862	209,655	112,745	96,910				

Monthly prices of beef cattle for six years at the cattle market in Chicago, Illinois.

Months.	1869.	1868.	1867.
January	$3 87½ to $8 00	$3 25 to $8 25	$3 50 to $7 00
February	4 00 to 8 03⅛	4 00 to 8 75	3 50 to 7 50
March	3 97 to 8 05	4 00 to 8 75	3 50 to 8 25
April	4 00 to 7 71½	4 00 to 9 00	5 00 to 8 75
May	4 45 to 7 66½	4 00 to 9 00	5 00 to 10 00
June	4 67 to 7 65	3 75 to 8 75	5 00 to 9 50
July	3 93 to 7 67	3 50 to 8 00	3 50 to 7 75
August	3 46 to 7 67	3 00 to 7 75	3 00 to 7 75
September	3 33 to 7 60	3 50 to 7 25	2 75 to 7 50
October	3 18 to 7 35	3 00 to 7 25	7 25 to 7 50
November	3 05 to 7 55	3 00 to 7 00	2 00 to 7 25
December	3 57 to 7 70	3 25 to 7 50	3 00 to 7 50
Annual average	3 79 to 7 66	3 41 to 8 10	3 52 to 8 02
Months.	**1866.**	**1865.**	**1864.**
January	$3 50 to $8 00	$2 50 to $9 00	$2 00 to $5 75
February	3 37½ to 7 00	3 50 to 9 25	2 59 to 6 75
March	3 75 to 7 50	4 00 to 9 75	2 75 to 7 00
April	3 00 to 7 25	2 50 to 10 00	2 75 to 7 50
May	4 00 to 8 50	3 00 to 8 87	3 50 to 8 50
June	4 50 to 8 50	3 50 to 8 00	2 75 to 9 00
July	4 00 to 8 00	3 75 to 7 25	2 50 to 8 00
August	4 00 to 8 25	2 50 to 7 25	2 50 to 7 50
September	3 75 to 8 00	2 50 to 8 00	2 50 to 8 25
October	3 75 to 7 50	2 50 to 8 00	2 50 to 7 50
November	2 00 to 7 00	2 50 to 8 40	2 25 to 7 25
December	2 75 to 7 12½	2 50 to 7 25	2 25 to 7 25
Annual average	3 53 to 7 72	2 94 to 8 46	2 56 to 7 52

ST. LOUIS.

Receipts of live stock during the year: cattle, 124,565; sheep, 96,626; hogs, 344,848. Total, 566,039, against the following for 1868: cattle, 115,352; sheep, 79,315; hogs, 301,569; total, 496,236.

PRICES.—The following shows the highest and lowest range of prices for each month during the year:

Months.	CATTLE, PER POUND, GROSS.		Hogs, per pound, gross.	SHEEP, EACH.	
	Choice.	Inferior.		Choice.	Inferior.
	Cents.	*Cents.*	*Cents.*		
January	5 to 7½	3 to 6	6½ to 10	$3 75 to $6 50	$1 25 to $3 50
February	5 to 7¼	2½ to 5	8½ to 10	6 00 to 7 00	1 25 to 5 50
March	6½ to 7¼	3 to 6	8½ to 10½	5 50 to 7 00	1 50 to 5 00
April	6½ to 7½	2¾ to 5	5½ to 9½	6 50 to 9 00	2 00 to 4 00
May	6 to 7¼	3½ to 5	5½ to 10	5 00 to 7 50	2 50 to 4 50
June	6 to 7	3¼ to 5	5¾ to 9½	5 00 to 6 00	1 50 to 4 00
July	5¾ to 6½	3 to 4½	6 to 9½	4 00 to 6 50	1 50 to 2 75
August	5½ to 6½	2 to 5	6 to 9½	4 00 to 5 00	1 25 to 2 00
September	5½ to 6½	2 to 5½	6½ to 10	4 50 to 5 50	1 50 to 3 00
October	5½ to 6½	3½ to 4½	6 to 10	4 50 to 5 00	1 50 to 3 00
November	5 to 6½	2½ to 4½	8½ to 10½	4 00 to 5 00	1 50 to 3 00
December	5 to 6½	2½ to 4½	7 to 10	4 00 to 4 50	1 25 to 2 50

PORK PACKING IN THE WEST.*

The following comparative statement shows the number of hogs packed in the principal Western States during the seasons of 1868–'69 and 1869–'70:

	1868–'69.	1869–'70.
Ohio	546, 261	517, 453
Illinois	805, 843	860, 231
Indiana	325, 514	248, 510
Kentucky	183, 426	197, 010
Missouri	368, 633	431, 615
Iowa	131, 287	139, 487
Wisconsin	129, 094	172, 626
Tennessee	9, 115	8, 330
Grand totals	2, 499, 173	2, 575, 262

Increase in 1869–'70, 76,089.

MEAT PRODUCTION IN EUROPE.

For the purpose of comparison with the foregoing statistics of live stock in this country, the following statement is appended, showing the number of live stock in European countries, according to returns made to the statistical departments of the respective countries:

Countries.	Date of returns.	Cattle.			Sheep and lambs.	Pigs.
		Cows.	Other kinds.	Total.		
Great Britain	1868	2, 143, 895	3, 280, 086	5, 423, 981	30, 711, 396	2, 308, 539
Ireland	1868	1, 463, 058	2, 157, 294	3, 620, 352	4, 822, 444	862, 443
Total United Kingdom, (including Isle of Man and channel islands)	1868	3, 625, 137	5, 458, 279	9, 083, 416	35, 607, 812	3, 189, 167
Russia in Europe, (exclusive of Poland and Finland)	(*)			22, 816, 000	39, 315, 000	9, 517, 000
Russia in Asia	(*)			2, 628, 000	5, 815, 000	580, 000
Sweden †	1866	1, 235, 000	750, 000	1, 985, 000	1, 650, 000	390, 000
Norway	1865			953, 036	1, 705, 394	96, 166
Denmark proper	1866	811, 831	382, 030	1, 193, 861	1, 874, 052	381, 512
Prussia	1867	4, 865, 898	3, 130, 920	7, 996, 818	22, 262, 087	4, 875, 114
Wurtemburg	1867	465, 943	445, 070	911, 013	655, 856	254, 888
Bavaria	1863	1, 521, 113	1, 641, 274	3, 162, 387	2, 039, 983	921, 456
Saxony	1867	413, 755	211, 505	625, 260	304, 087	325, 564
Holland	1866			1, 271, 563	1, 076, 374	321, 534
Belgium ‡	1856			1, 257, 649	583, 485	458, 418
France	1862	5, 781, 465	8, 415, 895	14, 197, 360	33, 281, 592	5, 246, 403
Spain	1865			2, 904, 598	22, 054, 467	4, 264, 817
Italy †	1867			3, 708, 635	11, 040, 339	3, 886, 731
Austria	1864	6, 094, 865	7, 565, 457	13, 660, 322	16, 573, 459	7, 914, 855
Switzerland	1866	627, 116	365, 779	992, 895	445, 400	304, 191

* Average of 1859 to 1863. † Estimate returns. ‡ Results of census of 1866 not yet known.

PRICES OF FARM PRODUCTS.

A record of prices of farm products in the principal cities, carefully collated from most reliable commercial reports, would be exceedingly valuable for reference; yet, however correct and judicious the work, the fact that the items of one locality are not identical either in classification or quality with those of another, must detract from its value. The following table is presented, and a more extended record, embracing a wider range of production, will be made hereafter:

* As reported by the Cincinnati Price Current.

Prices of certain products in 1869

Products.	January.	February.	March.	April.	May.
NEW YORK.					
Flour, State	$5 85	$5 75 to 7 30	$5 70 to 7 00	$5 85 to 7 25	$5 45 to 6 50
western	5 80 to 13 00	5 70 to 12 50	5 45 to 12 50	5 75 to 12 00	5 45 to 12 00
Wheat, spring	1 57 to 1 70	1 55 to 1 63	1 56	1 49 to 1 50	1 45 to 1 50
white, western	2 12 to 2 25		1 83	1 80	1 90 to 2 15
Corn, new western, mixed	93 to 96	91 to 94	93 to 94½	88 to 91	85 to 86
old western, mixed	1 07 to 1 10	1 04½ to 1 05	1 01 to 1 02	92 to 93	89
Rye	1 50 to 1 57			1 40 to 1 42	
Oats	76 to 78	74 to 77	74 to 75½	75 to 77¼	82
Hay, shipping qualities, per 100 pounds	85 to 95	80 to 85	75		60
Pork, prime mess, per barrel		28 50 to 30 50	28 50 to 30 50	28 75 to 30 00	28 25 to 28 75
Beef, plain, per barrel	9 00 to 15 00	9 00 to 15 00	9 00 to 16 00	9 00 to 14 00	9 00 to 14 00
extra	15 00 to 20 00	15 00 to 23 00	15 00 to 20 00	12 00 to 17 00	12 00 to 17 00
Butter, western	25 to 40	28 to 35	25 to 35	30 to 40	23 to 35
State	40 to 50	40 to 48	40 to 55	40 to 55	25 to 43
Cheese, dairy	14 to 18	13 to 18	16 to 21	18 to 21	19 to 22
factory	14 to 19½	14 to 21	16 to 22	19 to 22	21 to 23
Cotton, Upland and Florida middling	29 to 29¼	29¼	29½	29	28½ to 28¾
New Orleans and Mobile middling	29¼ to 29½	29½ to 29¾	29¾ to 30	29¼ to 29½	28¾ to 29¼
Tobacco, light leaf	7½ to 16	7½ to 16	7½ to 16	6 to 16	5 to 15
heavy western	8½ to 16	8½ to 16	8½ to 16	8 to 16	7½ to 16
Wool, fleece	45 to 70	45 to 70	45 to 70	45 to 70	43 to 70
CHICAGO.					
Flour, fair to choice red winter	6 87½ to 8 50	6 75 to 8 25	7 00 to 7 75	5 85 to 7 50	6 25 to 7 75
common to choice superfine, extra	5 25 to 6 50	5 00 to 6 25	5 00 to 6 25	4 75 to 6 00	4 70 to 6 00
Wheat, No. 1 red winter*					
No. 1 spring	1 19 to 1 28	1 18 to 1 24½	1 16 to 1 23	1 14 to 1 20	1 13 to 1 18
Corn, No. 1	62 to 65	62 to 64		64½ to 66	58 to 60
Oats, No. 2	46½ to 48¼	49 to 53	53¾ to 56½	52¾ to 55½	56¾ to 60
Rye	1 14 to 1 19	1 16 to 1 17	1 18 to 1 20½	1 18 to 1 21	1 16 to 1 17
Hay, timothy, and clover, ton	15 50 to 16 50	17 00 to 18 00	15 50 to 16 50	16 00 to 17 00	16 00 to 17 00
Beef, extra mess	14 50 to 15 00	14 50 to 15 50	13 50 to 14 50	14 00 to 14 50	14 00 to 15 00
mess	13 50 to 13 75	13 00 to 14 50	12 00 to 13 50	12 00 to 13 50	12 00 to 13 50
Pork, prime mess	24 00 to 25 00	28 50 to 29 00	27 50 to 28 50	25 90 to 26 25	27 00 to 27 50
Butter, firkins and tubs	30 to 36	30 to 32	30 to 34	29 to 33	
Cheese, New York factory	20 to 21	23 to 24	25 to 26	24 to 25	24 to 25
west. factory	19 to 20	21 to 22	23 to 24	23 to 24	23 to 24
Wool, common to extra, tub washed	50 to 55	48 to 54	46 to 54	45 to 54	45 to 55
common to fine fleece	40 to 44	40 to 46	40 to 46	40 to 47	40 to 47
ST. LOUIS.					
Flour, spring, extra	5 75 to 6 75	5 50 to 6 25	4 75 to 5 50	4 50 to 5 25	4 75 to 5 12
fall, extra	6 25 to 7 25	6 00 to 6 75	5 25 to 6 50	5 25 to 5 75	4 75 to 5 75
Wheat, choice fall	1 80 to 2 00	1 80 to 2 00	1 65 to 1 95	1 75 to 2 00	1 70 to 1 90
No. 1 spring	1 30 to 1 40	1 35 to 1 40	1 16 to 1 35	1 09 to 1 23	1 14 to 1 17
Corn, white, in sacks	65 to 73	68 to 76	61 to 72	63 to 78	63 to 80
mixed, in sacks	61 to 70	67 to 73	65 to 69	62 to 65	58 to 72
Oats, choice, in sacks	55 to 62	63 to 73	56 to 70	57 to 66	64 to 70
Rye	1 25 to 1 33	1 25 to 1 33	1 25 to 1 40	1 22 to 1 30	1 10 to 1 26
Barley, choice spring	2 50 to 2 70	2 70 to 2 75	2 50 to 2 75	2 00 to 2 25	2 15
Hay, choice, per ton	20 00 to 23 00	24 00 to 27 00	21 00 to 25 00	26 00 to 30 00	24 00 to 30 00
Mess pork, prime	28 00 to 32 00	31 00 to 34 00	31 00 to 32 50	30 50 to 31 50	31 00 to 31 50
Cotton, middling	24 to 28½	28 to 28½	27 to 28	26 to 27	26½ to 27
Tobacco, common leaf	6 50	6 00	6 25	6 30	6 55
Wool, fleece washed	32 to 37	32 to 37	32 to 37	32 to 38	32 to 38
tub washed	45 to 50	45 to 50	45 to 50	38 to 49	38 to 52
CINCINNATI.					
Flour, superfine		5 50 to 6 00	5 00 to 5 50	5 00 to 5 50	5 00 to 5 50
Wheat, No. 1, white	2 10	2 00 to 2 10			
No. 1, red	1 73 to 1 75	1 70	1 50 to 1 53	1 45	1 40
Corn, No. 1	65 to 66	68	61 to 65	63	66
Oats, No. 1	60	64	67 to 68	65	68
Rye, No. 1	1 36	1 37 to 1 40	1 45	1 41 to 1 42	1 37 to 1 38
Hay, light pressed, per ton	15 00 to 16 00	16 00 to 17 00	17 00 to 18 00	18 00 to 19 00	21 00 to 22 00
Beef, mess, per barrel	21 50 to 22 00	19 00 to 20 00	19 00 to 20 00	18 00 to 19 00	17 50 to 18 00
Pork, city, mess	28 50 to 29 00	31 50 to 32 00	32 00	31 50	30 50 to 31 00
Butter, choice, Ohio	34 to 36	28 to 30	38 to 40	42 to 45	33 to 35
Cheese, Western Reserve	17½ to 18	19 to 20		15 to 22	16 to 18
Wool, fine fleece and combing	42 to 45	42 to 45	49 to 50	40 to 50	42 to 45
tub	50 to 52	50 to 52	50 to 53	50 to 53	42 to 45

* During the year No. 2 red winter ranged in prices below No. 1 from two to five cents per bushel.

in some of the principal cities.

June.	July.	August.	September.	October.	November.	December.
$5 25 to 6 45	$4 85 to 6 50	$5 90 to 7 40	$5 85 to 7 10	$5 85 to 6 65	$5 25 to 6 20	$4 85 to 6 25
5 25 to 12 00	4 75 to 11 00	5 90 to 10 00	5 90 to 10 00	5 75 to 9 00	5 15 to 8 50	4 75 to 9 00
1 41⅓ to 1 46	1 41 to 1 48	1 53	1 44 to 1 52½	1 45	1 30 to 1 40	1 26 to 1 35½
1 65½ to 1 73			1 60	1 58	1 50 to 1 55	
55 to 73	62 to 86					
82 to 86		1 05 to 1 08	1 16 to 1 18½	1 03 to 1 05	1 03 to 1 05	1 12 to 1 13½
77 to 73¾	74 to 76	82 to 85	61 to 64	62½ to 65	63 to 66	64½ to 65½
60	60	60	55 to 60		65 to 70	65
28 00 to 28 50	28 37 to 29 25	29 25 to 30 00	30 50	29 25 to 30 00	27 00 to 28 00	27 50 to 30 50
9 00 to 14 00	9 00 to 14 00	9 00 to 14 00	5 00 to 13 00	5 00 to 13 00	5 00 to 13 00	5 00 to 13 00
12 00 to 17 00	12 00 to 17 00	12 00 to 17 00	10 00 to 17 00	10 00 to 17 00	10 00 to 17 00	10 00 to 17 00
30 to 35	20 to 33	16 to 32	16 to 28	16 to 28	20 to 33	20 to 33
36 to 38	30 to 37	30 to 36	30 to 37	30 to 42	30 to 46	30 to 45
14 to 22						
21 to 22½	11 to 17	11 to 15	11 to 16	13 to 16½	17 to 18¾	17 to 18
29½	34½	33¼	35	27½	26½	25¼
29½ to 29¾	34¾ to 35	33¾ to 34	35¼ to 35½	27¾ to 28	26⅜ to 26⅝	26 to 26¼
7 to 15		7 to 15	7 to 14		8¼ to 15	8¼ to 14
8½ to 16						
42 to 65	43 to 65	43 to 65	43 to 65	43 to 65	43 to 65	40 to 65
6 00 to 7 50	5 75 to 7 50	6 25 to 7 75	6 00 to 7 50	5 50 to 7 00	5 25 to 6 25	5 00 to 5 60
4 75 to 6 00	5 00 to 6 25	5 75 to 7 00	5 25 to 6 75	4 75 to 6 25	4 75 to 5 50	3 50 to 5 25
		1 37 to 1 45	1 29 to 1 38	1 08 to 1 15	90 to 96	1 02 to 1 05
1 12 to 1 19	1 21 to 1 31½	1 39 to 1 43	1 26 to 1 36	1 11 to 1 16	90 to 96	86 to 94½
67 to 69	68 to 74	88 to 95	88 to 89½	70 to 77½	66½ to 67	
58½ to 60¾	61¾ to 65½	52½ to 59	44 to 46	39½ to 42¾	38 to 41	40 to 44¾
1 00 to 1 04	1 00 to 1 07	1 00 to 1 02	94 to 1 00	82 to 85	70 to 73	72 to 75
19 50 to 20 00	18 00 to 19 00	18 00 to 20 00	16 00	16 00	15 00	15 00
14 00 to 15 00	14 00 to 15 00	14 00 to 15 00	14 00 to 15 00	15 00	13 00 to 14 00	13 00 to 13 50
12 50 to 13 50	12 00 to 13 50	12 00 to 13 50	12 00 to 13 50	13 50	12 00 to 13 00	
27 00 to 27 50	27 75 to 28 25				25 00	25 00 to 27 50
25 to 28	25 to 27	24 to 26	24 to 26	25 to 27	25 to 27	24 to 26
21 to 22	18 to 19	15 to 16	16 to 17	18 to 19	20 to 21	19 to 20
20 to 21	17 to 18	13 to 14	14 to 15	17 to 18	19 to 20	17 to 18
40 to 50	48 to 53	47 to 53	45 to 55	45 to 55	44 to 53	45 to 53
35 to 45	36 to 44	35 to 43	38 to 47	36 to 46	36 to 43	35 to 43
4 75 to 5 35	5 25 to 5 85	5 25 to 5 75	4 65 to 5 00	4 25 to 4 60	3 50 to 4 25	3 50 to 4 25
5 00 to 5 75	5 50 to 6 25	5 50 to 6 25	5 12 to 5 50	4 70 to 5 00	4 25 to 5 00	4 25 to 4 75
1 35 to 1 60	1 30 to 1 45	1 30 to 1 55	1 14 to 1 27	1 20 to 1 35	1 12½ to 1 27	1 10 to 1 40
1 19 to 1 25	1 17 to 1 25	1 23		1 00	90 to 95	95 to 98
68 to 93	85 to 1 13	89 to 1 09	90 to 1 05½	85 to 1 00	80 to 1 10	80 to 1 00
65 to 80	80 to 1 08	80 to 90	86 to 96	76 to 88	75 to 95	76 to 90
63 to 70	65 to 76	50½ to 56½	47 to 55	47 to 53	45 to 71	48 to 60
88 to 1 55	1 00 to 1 25	80 to 1 05	80 to 90	60 to 86	70 to 76	78 to 84
			1 75 to 2 00	1 80 to 1 90	1 40 to 1 65	1 45 to 1 60
18 00 to 25 00	23 00 to 32 00	16 50 to 23 00	16 00 to 22 00	18 00 to 22 00	18 50 to 20 00	17 00 to 19 00
31 00 to 33 75	32 50 to 34 00	34 00 to 34 50	32 00 to 34 00	29 50 to 32 50	28 50 to 31 00	22 50 to 31 00
27 to 33	32 to 33	31¾ to 32	27 to 32	24 to 25½	23 to 24½	23 to 24
7 75	7 55	7 45	8 85	9 25	9 75	9 00
32 to 43	32 to 48	32 to 48	40 to 45	31 to 45	33 to 43	33 to 43
38 to 53½	45 to 55	48 to 55	52 to 55	47 to 53	47 to 53	48 to 53
4 50 to 4 60	4 75 to 4 90	5 00	4 75 to 5 00	4 50 to 4 75	4 65 to 4 85	4 25 to 4 65
		1 45	1 40	1 35 to 1 40		
1 20	1 30	1 25	1 25	1 15	1 12 to 1 15	1 10 to 1 14
64 to 66	72 to 73		1 00 to 1 03	93 to 94	87	1 00
69 to 70	69		56 to 57	56 to 57	52 to 53	52 to 55
1 20	1 14 to 1 15	90 to 92	1 00 to 1 02	95 to 96	93 to 95	94 to 95
18 00 to 19 00	17 00 to 18 00	17 00 to 18 00	15 00 to 17 00	16 00 to 17 00	16 00 to 17 00	15 00 to 16 00
17 50 to 18 00	15 50 to 16 00	15 50 to 16 00				
31 00 to 31 25	32 50 to 32 75	33 50	33 00 to 33 25	31 25 to 31 50	31 00	23 50 to 31 50
22 to 24	24 to 25	26 to 27	27 to 29	30 to 33	30 to 33	30 to 33
16 to 17	14 to 15	12½ to 13	13½ to 14	15½ to 16	17½ to 18	17 to 18
45 to 50	45 to 50	40 to 43	45 to 50	45 to 50	45 to 50	45 to 50
42 to 44	45 to 50	45 to 51	45 to 51	45 to 52	45 to 52	45 to 50

while winter ranged above No. 1 red from two to fifteen cents per bushel according to quality. † New.

In the San Francisco market flour ranged from $4 to $5 75, beginning in January with $4 50 to $5 75, and closing in December with $4 to $5. Wheat, in January, brought $1 50 to $1 85 per 100 pounds, beginning to decline in April, and, after various fluctuations, selling in December at $1 10 to $1 60; that from Oregon was more uniform in price, the best bearing nearly the same quotations as the best California, and the lower quotations 25 to 40 cents above the poorer qualities of California wheat. Corn, $1 80 to $1 90 per 100 pounds in January, and $1 05 to $1 15 in December. Oats, $1 90 to $2 35, falling during the year to $1 50 to $1 75. Hay, per ton, highest in January, $14 to $22, and lowest in November, $7 50 to $15. Mess beef per barrel, ranging from $16 to $20; mess pork, $16 to $29; butter, 50 to 75 cents in January, 30 to 35 in May, 35 to 50 in August, and 40 to 50 in December; cheese 18 to 21 in January, and 15 to 20 in December; native wool, 8 to 15; American wool, 13 to 18 in January, 12½ to 14 in December.

IMPORTS OF WOOL AND WOOLENS.

Statement showing the imports of wool and woolens into the United States during the year ending June 30, 1870, furnished by Edward Young, chief of Bureau of Statistics, Treasury Department.

	Quantity.	Value.
Raw and fleece .... pounds..	49, 230, 199	$6, 743, 350
Cloths and cassimeres	....	7, 671, 013
Woolen rags, shoddy, mungo, waste, and flocks .... pounds..	512, 792	55, 609
Shawls	....	1, 867, 874
Blankets	....	21, 952
Carpets .... square yards..	3, 729, 904	3, 940, 707
Dress goods .... square yards..	61, 362, 034	15, 447, 960
Hosiery, shirts, and drawers	....	441, 598
Manufactures not specified	....	5, 043, 919
Total	....	41, 233, 982

AGRICULTURAL EXPORTS.

Statement of the exports of agricultural products of the United States, with their immediate manufactures, for the year ended June 30, 1870, furnished by Edward Young, chief of Bureau of Statistics, Treasury Department.

Products and manufactures.	Quantity.	Value.
Animals, living:		
Hogs .... number..	12, 258	$189, 753
Horned cattle .... do...	27, 510	439, 987
Horses .... do...	2, 140	177, 498
Mules .... do...	995	140, 350
Sheep .... do...	37, 531	95, 174
All other, and fowls .... do...	....	2, 277
Animal matter:		
Hides and skins, other than fur	....	365, 441
Pork .... pounds..	25, 649, 831	3, 253, 137
Hams and bacon .... do...	38, 977, 879	6, 123, 043
Lard .... do...	35, 798, 530	5, 933, 397
Lard oil .... gallons..	90, 774	124, 860
Neatsfoot and other animal oils .... do...	501	649
Beef .... pounds..	26, 728, 573	1, 939, 758
Preserved meats	....	313, 757
Tallow .... pounds..	37, 413, 056	3, 814, 861
Hair, unmanufactured	....	207, 056
manufactured	....	4, 863
Butter .... pounds..	2, 039, 488	592, 249
Cheese .... do...	47, 296, 323	8, 881, 934
Eggs .... dozens..	874	322
Candles, tallow, and other .... pounds..	2, 277, 713	373, 524

Exports of agricultural products of the United States, &c.—Continued.

Products and manufactures.	Quantity.	Value.
Animal matter—Continued.		
Soap, perfumed ... pounds		$4, 637
other ... do	7, 028, 843	622, 715
Glue ... do	22, 354	5, 621
Wax ... do	346, 668	137, 443
Leather of all kinds, not specified ... do	373, 224	106, 312
morocco and other fine ... do		4, 765
boots and shoes ... pairs	274, 497	417, 574
saddlery and harness		55, 379
manufactures, United States		87, 263
Wool ... pounds	152, 892	54, 928
manufactures, United States		124, 159
Furs and fur skins		1, 941, 139
Bones and bone-dust ... cwt	45, 928	75, 583
Bone-black, ivory-black, &c ... pounds	679, 134	32, 487
Breadstuffs:		
Indian corn ... bushels	1, 302, 115	1, 287, 575
meal ... barrels	186, 946	934, 936
Wheat ... bushels	37, 590, 539	47, 213, 945
flour ... barrels	3, 457, 005	21, 126, 877
Rye ... bushels	157, 606	178, 275
flour ... barrels	6, 974	38, 458
Barley ... bushels	255, 090	140, 512
Other small grain and pulse		384, 198
Rice ... pounds	2, 133, 022	127, 655
Bread and biscuit ... do	10, 158, 658	581, 786
Macaroni, vermicelli, and all other preparations from breadstuffs		287, 843
Cotton: unmanufactured Sea Island ... pounds	6, 309, 780	2, 986, 433
other ... do	954, 148, 843	224, 121, 191
manufactures, colored ... yards	6, 037, 589	1, 032, 125
uncolored ... do	8, 256, 943	1, 343, 229
all others		1, 404, 973
Wood, and manufactures of wood:		
Boards, clapboards, &c ... M feet	142, 673	2, 920, 429
Laths, palings, pickets, &c ... thousands	8, 044	38, 296
Shingles ... do	28, 784	113, 431
Box shooks		374, 338
Other shooks, staves, and headings		4, 897, 641
Hogsheads and barrels, empty ... number	162, 177	277, 284
All other lumber		369, 010
Firewood ... cords	8, 341	20, 725
Hop, hoop, and other poles		529, 427
Logs, masts, spars, and other whole timber		535, 522
Timber, sawed and hewn ... cubic feet	7, 115, 975	1, 219, 074
All other timber		193, 600
Household furniture		1, 245, 516
All other manufactures of		1, 090, 545
Bark for tanning		216, 488
Ashes: pot and pearl ... pounds	2, 316, 877	168, 731
Rosin and turpentine ... barrels	583, 185	1, 776, 214
Tar and pitch ... do	47, 532	143, 871
Apples: green or ripe ... bushels	164, 925	230, 002
dried ... pounds	836, 116	79, 398
Fruit: green, ripe, or dried		151, 372
Potatoes ... bushels	596, 964	412, 488
Onions ... do	59, 089	98, 909
Pickles and sauces		16, 159
Vegetables, prepared or preserved		37, 889
not specified		52, 115
Clover seed ... bushels	272	1, 763
Flax seed ... do	35	129
Linseed oil ... gallons	21, 803	22, 973
Castor oil ... do	263	713
Essential oil		288, 465
Oil cake ... pounds	156, 585, 059	3, 419, 288
Hemp, unmanufactured ... cwt	4, 240	45, 260
manufactured, cables and cordage ... do	14, 226	213, 496
all others		66, 806
Hops ... pounds	16, 356, 231	2, 515, 724
Hay ... tons	6, 723	117, 137
Ginseng ... pounds	474, 310	455, 097
Salt ... bushels	297, 976	119, 582
Beer, ale, porter, and cider in bottles ... dozens	1, 072	2, 268
casks ... gallons	66, 467	22, 759
Spirits distilled from grain ... do	23, 370	47, 218
molasses ... do	872, 858	653, 184
other materials ... do	19, 403	25, 019
Spirits of turpentine ... do	3, 246, 702	1, 557, 302
Wine ... do	32, 809	42, 137
Molasses ... do	299, 672	89, 912
Vinegar ... gallons	60, 257	13, 774

Exports of agricultural products of the United States, &c.—Continued.

Products and manufactures.	Quantity.	Value.
Sugar, brown........pounds..	12, 476	$1, 403
refined........do....	4, 415, 100	555, 482
Candy and confectionery........do....	....	14, 729
Cigars........M..	2, 064	9, 750
Snuff........pounds..	20, 181	12, 226
Tobacco, manufactured........do....	....	1, 582, 995
leaf, unmanufactured........do....	185, 747, 181	21, 100, 230

RECAPITULATION.

Animal production........	$36, 643, 895
Breadstuffs........	72, 302, 060
Cotton manufactures........	230, 807, 951
Wood and its products........	13, 951, 326
Miscellaneous........	35, 969, 749
	389, 674, 981

CANE SUGAR PRODUCTION.

The consumption of sugar in the United States is yearly increasing, and now exceeds 500,000 tons. Nearly all of this is sugar from the cane. No appreciable quantity has yet been made from sorghum, and it is not practicable to extend materially the production from the sugar maple. Beet sugar, constituting nearly the entire supply of Europe, and about one-fourth of the sugar product of the globe, has not yet been produced extensively here. It will ultimately become a great interest, unless it fails in competition with the superior economy of cane sugar.

Louisiana produced last year, according to the statistics of L. Bouchereau, 99,452,946 pounds of sugar, or 87,090 hogsheads, of 1,142 pounds each. This is a small increase over the product of the previous year, 95,051,225 pounds, or 84,256 hogsheads. It is about one-tenth of the amount annually consumed in the United States. A small quantity produced elsewhere, as in Texas or Florida, may increase the proportion of home-grown sugar to one-eighth of the consumption. The Louisiana crop is grown upon an acreage scarcely larger than the original area of the District of Columbia—ten miles square. The capital and labor provided, it will be a perfectly feasible thing to produce in that one State all the sugar required in the country. One-tenth of the area devoted to cotton, if properly cultivated—say 800,000 acres—would suffice to supply our present wants. The average yield per acre is now, under present culture, about 1,300 pounds. This crop is now grown on the finest soil in the South, the deep alluvion of the Mississippi and other rivers; and while large areas of similar lands are yet available, it is true that a tenfold extension would appropriate lands less fertile and less accessible to markets, yet not unprofitable for culture. Few rural avocations yield a better return, at present prices, than the production of sugar from the cane. M. Bouchereau estimates the returns of a man's labor for the year at $1,416, produced from eight acres, each yielding 1,350 pounds, at 10 cents, and 70 gallons of molasses, at 60 cents per gallon. Improved lands, suitable for cane culture, can be obtained for $25 to $40 per acre, and unimproved lands still cheaper.

The crop of 1860, in Louisiana, was 228,758 hogsheads, weighing 263,065,000 pounds, produced in 1,292 sugar houses, 1,009 worked by steam-power, 283 by horse-power. The production of molasses for the same year was 18,414,550 gallons. The crop of 1861, the largest ever grown, was 459,410 hogsheads. This was the last of which a complete record is attainable, until

the close of the war, when the business was almost entirely abandoned. The recuperation has necessarily been slow, a large portion of each year's canes being required as plants for increased acreage. In 1864 the product, in round numbers, was 7,000 hogsheads; this result was doubled in 1865; in 1866 the product had risen nearly to 40,000 hogsheads; in 1867 the increase was small; but the crops of the past two years have been double those of the years 1866 and 1867. It was feared, early last season, that cane would prove a failure, in consequence of poor tillage in the fall, the bad condition of the new plants, and injury to the stubbles of previous years, with heavy rains in the spring, which prevented proper summer cultivation. The season for grinding was peculiarly favorable, and opened earlier than in the previous year. The crop was reduced by the Pointe Coupée, Roman, Lafourche, and Villere crevasses, and in consequence of the submerging of several plantations by summer storms; otherwise a large increase over the product of 1868 would have been obtained.

The number of sugar-houses in operation during the past year was 817, of which 664 were run by steam-power, 153 by horse-power; the number of open kettles, 863; open pans, 81; vacuum pans, 53; the number of portable mills was 44; hogsheads of sugar, 87,090; gallons of molasses, 5,724,256.

The following table gives the amount of each crop since 1823, except those of 1830, 1831, 1862, and 1863:

	Hhds.		Hhds.		Hhds.
1823	30, 000	1840	87, 000	1854	346, 635
1824	32, 000	1841	90, 000	1855	231, 427
1825	30, 000	1842	140, 000	1856	73, 976
1826	45, 000	1843	100, 000	1857	279, 697
1827	71, 000	1844	200, 000	1858	362, 296
1828	88, 000	1845	186, 000	1859	221, 840
1829	48, 000	1846	140, 000	1860	228, 758
1832	70, 000	1847	240, 000	1861	459, 410
1833	75, 000	1848	220, 000	1864	6, 668
1834	100, 000	1849	247, 923	1865	15, 000
1835	30, 000	1850	211, 201	1866	41, 000
1836	70, 000	1851	236, 547	1867	37, 647
1837	65, 000	1852	321, 934	1868	84, 256
1838	70, 000	1853	449, 324	1869	87, 090
1839	115, 000				

HEMP AND FLAX.

The hemp product, mainly obtained from Kentucky and Missouri, has been greatly reduced since 1859, when the yield of the former State was 39,409 tons; of the latter, 19,268 tons; and of the entire country, 74,493 tons. Scarcely half this quantity is now produced.

The culture of flax has been greatly extended during the past ten years; the war, which directly interfered with the culture of hemp, incidentally favored the production of flax. It is readily grown throughout the North and West, and when the high rate of gold, advancing the prices of all fibers, afforded a strong protection to the interest, a marked increase of the flax acreage immediately resulted. The investigation concerning improved modes of manufacture, directed by Congress, and conducted by the Department of Agriculture, while it did not overcome the difficulties in the way of cottonizing flax, gave the business a new impetus, which is not yet exhausted, and which promises a material augmentation of the products of industry. Within two years past, flax-

tow, manufactured from fiber formerly cast aside as worthless, and left to rot by the roadside, has been used in the manufacture of bagging, which has met with much favor in the South, and it is to be hoped that it may in the future supersede all other material for cotton-bagging. In 1867 the mills for preparing flax-tow in the States of Ohio, Illinois, Indiana, Iowa, Wisconsin, and Michigan, numbered 90. Since the decline of gold the wholesale importation of jute and jute-butts has injured the market for this fiber for its ordinary uses, but the manufacture of bagging alone now employs 14 factories, running about 140 looms, while 137 are employed on jute, and 90 on hemp—enough to manufacture the covering for three millions of bales of cotton. In view of the fact that four-fifths of our flax-fiber is wasted, the seed only being utilized, and the pregnant fact that $23,000,000 were paid in 1869 for foreign fibers, it is of the first importance to find new uses for this material, and learn to economize processes that shall insure its profitable manufacture.

The amount of flaxseed returned by the census of 1850 was 562,312 bushels; by that of 1860, 566,867 bushels. The great advance which the census of 1870 will show is foreshadowed by the increase in Ohio, from 242,420 bushels in 1859 to 620,092 in 1869; and that of New York, from 56,991 bushels in 1859 to 130,318 in 1869. Iowa produced 5,921 bushels in 1859, and 96,395 in 1869.

IMMIGRATION.

The population of the country has had large accessions from immigration during the past year. From the records of the Bureau of Statistics of the Treasury it appears that 385,084 foreigners have sought a home among us, of whom 124,241 came from the German States, 95,-294 from Great Britain, and 51,199 from Ireland. The number from France is but 2,556. From China and Japan 14,919 are credited. A large immigration is noted from the British North American provinces, aggregating 26,671.

The following table gives the nationality of the immigrants of 1869:

Countries.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Total.
Great Britain	9,023	33,574	30,580	22,117	95,294
Ireland	3,878	26,133	12,527	8,656	51,199
German States	12,158	50,999	31,508	26,576	124,241
Norway, Sweden, and Denmark	468	20,169	8,153	4,474	33,264
Holland			280	253	533
Belgium			407	238	645
Switzerland	608	1,680	492	662	3,442
France	218	153	1,081	1,104	2,556
Spain and Portugal	193	38	521	149	901
Italy	209	105	466	739	1,519
Russia and Poland			349	102	451
South of Europe, not stated	953	1,742			2,695
Other countries of Europe	360	2,780	14	7	3,165
China and Japan	1,380	5,984	5,590	1,965	14,919
Africa			17	2	19
British North American Provinces	5,628	3,128	8,815	9,100	26,671
Mexico	59	68	70	119	316
South America	2		12	22	36
Cuba			542	378	920
West Indies	614	506	94	179	1,393
Azores			160	50	210
All other countries, and not stated	526	18,923	1,204	46	20,699

The occupations of these immigrants are thus stated, with the number of each calling: clergymen, 295; physicians, 236; artists, 224; me-

chanics, 7,401; bakers, 1,008; butchers, 722; seamstresses, 364; shoemakers, 1,798; sailors, 1,835; masons, 2,483; other trades, 2,326; clerks, 1,745; farmers, 30,731; laborers, 92,457; merchants, 7,415; miners, 6,170; mariners, 1,417; servants, 16,460; all other occupations, 1,105; occupation not stated, 6,639; without occupation, 182,857.

DIRECTION OF THE MOVEMENT.

The following unofficial statement of the direction taken by immigration arriving at New York is an indication of the preferences of foreigners in making homes in this country, except that in the case of New York it should be remembered that a large portion of those credited to this State do not make it their permanent residence, but are found west of the lakes within a few months.

States.	1868.	1869.	States.	1868.	1869.
Arkansas	78	18	Montana	14	18
Alabama	114	104	New Hampshire	411	192
British Columbia	66	18	Nova Scotia	150	49
Canada	2, 723	2, 564	New York	65, 714	82, 372
California	3, 989	3, 594	New Jersey	5, 916	7, 743
Connecticut	3, 458	3, 922	Nebraska	1, 410	1, 641
Colorado	38	91	North Carolina	114	117
Central America	21	2	New Brunswick	113	59
Cuba	14	6	Nevada	18	40
Delaware	409	143	New Mexico	5	5
District of Columbia	873	395	Ohio	11, 133	11, 738
Dakota	38	9	Oregon	30	23
Florida	34	20	Pennsylvania	16, 926	30, 746
Georgia	127	117	Rhode Island	2, 279	2, 227
Illinois	34, 625	37, 313	South Carolina	148	140
Iowa	7, 040	8, 026	South America	185	61
Indiana	3, 852	3, 025	Texas	266	285
Idaho	15	7	Tennessee	540	495
Kentucky	1, 392	842	Vermont	533	498
Kansas	1, 085	1, 632	Virginia	731	777
Louisiana	567	237	West Indies	14	25
Massachusetts	7, 604	8, 158	Wisconsin	16, 537	16, 632
Maryland	1, 604	1, 524	West Virginia	22	140
Maine	293	222	Utah	3, 115	2, 325
Michigan	7, 324	6, 939	Wyoming	....	5
Minnesota	5, 891	6, 725	Newfoundland	....	1
Missouri	6, 517	4, 723	Arizona	....	104
Mexico	14	7	Australia	....	1
Mississippi	84	98	Brazil	....	1
Chili	....	1	Japan	....	1
China	....	5	Lima	....	5

Other statistical investigations, upon various topics of special interest, are presented in the report of the editor of this annual.

During the year statistical statements are prepared, in response to congressional resolutions, memorials of industrial societies, and requests of individuals, upon subjects of public importance, for which there is no space in this volume.

J. R. DODGE.

HON. HORACE CAPRON,
Commissioner.

REPORT OF THE ENTOMOLOGIST.

The arrangement of the agricultural museum in the new hall of exhibition has occupied the entire official time of the entomologist during the past year. From the nature of the work it has been necessarily slow in progress, all the specimens requiring handling many times to prepare them properly, and much labor and research in the labeling, to say nothing of delays caused by not always having proper materials and fixtures at hand, or the means to procure them. Though in the fifth year of its existence, the collection is far from what it should be, in variety and value of specimens, to give satisfaction to its friends and the public; still it has grown, mainly through the efforts and contributions of individuals, and of other institutions with which exchanges have been effected.

Although a description of the design of the museum has been given in a former report, it will not be amiss to sketch here a brief outline of its main features, and of the objects sought to be accomplished through its agency.

A national agricultural and economic museum suggests what it is intended to comprehend as a whole. In detail the aim will be to make the collection not only illustrative of the agricultural interests of the country in the exhibition of farm products and the manufactures therefrom, but to show also how these products are affected by different climates and processes of cultivation, and what insects, birds, and animals are especially injurious or beneficial to them.

Cotton, as an example, is exhibited in the case of vegetable fibers, showing the plant entire, with the roots, leaves, and bolls; then the different kinds of seeds and nearly a hundred samples of cotton from various sources, native and foreign, in the boll, ginned, labeled, and manufactured, cotton seed, oil cake, &c.; each specimen being labeled, giving its origin, donor, and reference to standard works where directions for planting and culture may be found. The planter having examined this collection and desiring to know what enemies he may have to contend with in the cotton field, is shown a series of copper-plate engravings illustrating the growth of the plant, from the sprouting of the seed till the bolls are ready for the hand of the picker, together with all the diseases incident to it, the rust, rot, blight, &c., and all the insects which feed upon it, with their various transformations, habits, and names, with suggestions as to the best methods of destroying them. All other prominent vegetable fibers—flax, hemp, China grass or ramie, jute, &c.—are treated in the same way as far as practicable or necessary.

Next to cotton in interest is the ramie, (*Boehmeria nivea* or *tenacissima*,) sent to the Department some time ago by Messrs. Wade & Sons, of Bradford, England. This collection comprises specimens of the rough fiber or bark as imported by the manufacturers from the East Indies, and the fiber combed, carded, dyed, spun, and woven. In nearly all the fabrics yet received from this source the ramie is more or less mixed with wool and cotton. C. P. Dennett, of France, has contributed a small assortment of the same fibers, and specimens of the ribbons made of ramie and silk. H. Bonzano, of New Orleans, Louisiana, has furnished some specimens made of the ramie without any admixture of other fiber; these consist of small pieces, and one or two handkerchiefs of a silky linen-like texture. Miscellaneous specimens, both crude and prepared, have been received from Mr. Roezl, and planters in Louisiana and elsewhere.

Flax and hemp are shown in their respective places, from the different varieties of seed, through all the stages of development from the rough fiber to the various manufactured articles made from them. In connection with flax and hemp may be found the results of experiments made by the flax committee, during the great scarcity of cotton in 1864, to cottonize other fibers. The attempts to discover and utilize new fibers and to put old ones to new uses will be well remembered, and here is a record of much that was done both by the committee and by individual enterprise. The *asclepias*, or silk-weed fiber, may be mentioned here as the principal plant, aside from flax and hemp, on which attempts at cottonizing were made; but it was the fiber from the stalk alone, and not, as many suppose, the silky down of the pod, which proved of any value; and even that was not found to be sufficiently productive to make it an article of commerce, although possessing great strength and luster, and capable of being bleached and cottonized as readily as flax, as is here shown by the samples preserved.

Among the miscellaneous vegetable fibers may be mentioned specimens of jute from various sources, Pito or Ixtle fiber, (*Bromelia sylvestris*,) from New Mexico and South America; New Zealand flax, (*Phormium tenax*,) and many varieties of Yucca, Agave, Hibiscus, and other tropical and semi-tropical fibers, including also palm, silk-cotton, and what is known as Tampico fiber, which is used instead of bristles in the manufacture of certain kinds of brushes.

The museum is greatly indebted to the Smithsonian Institution for a large and valuable collection of tropical fibers and other objects of utility and interest from Demerara.

Among animal fibers are a few fine samples of merino wools from Ohio, Vermont, and California, and some improved combing wools from the flock of R. W. Scott, of Kentucky. W. M. F. Arny, of New Mexico, has furnished samples of native graded and improved wools of that region, and a heavy blanket woven in colors by the Indians from their native wools. The wool department, however, is very meager, owing partly to the apathy among producers in furnishing specimens, and partly to the great difficulty of preserving those sent from the ravages of insects.

The Angora wools on exhibition are chiefly from the flock of B. R. Tully, of Russellville, Kentucky, and those imported from Asia Minor by Israel S. Diehl. The collection of Mr. Diehl is interesting, as showing the long silky wool or hair of the Angora goat, and the fine short wools of the Cashmere, together with yarns, stockings, camlets, shawls, &c., manufactured from them.

The silk case is one of much interest, containing every species of silk-producing insect it has been possible to procure, both wild and cultivated, native or foreign, together with cocoons from them and specimens of the silk reeled and manufactured. The contributions to this collection by the late Louis Prevost, of San José, California, is of great value, as showing by results of experiments through several consecutive years how certain varieties of silk worms imported from Japan enlarged the size of their cocoons, and improved the quality of the silk by being reared in California. In the silk case also are shown eggs of the silk worm moth, the caterpillar chrysalis, and perfect insects, cocoons in different stages of preparation for reeling, skeins and spools of raw reeled silk, the silk bags or gut as dissected from the worm, and as made into the fiber commonly known as gut, and used at the end of fishing lines, &c. Some fine specimens of cocoons were brought from Broussa and other localities in Asia Minor by Mr. Diehl; but the greater

part of the collection, aside from the specimens contributed by Mr. Prevost, was furnished by Monsieur Guerin-Meneville, of Paris, France.

The growing demand for paper stock in greater quantity, and of better quality, has, within the last few years, developed a great industry in that direction; and many of the experimenters on various materials have furnished samples of their work for exhibition in the museum. The collection embracing the greatest variety of papers from any one material is that made from the husks or outer envelopes of maize, (Indian corn,) and sent from Austria to this Department in 1863. It comprises specimens of superior drawing and tracing papers, plain and colored, with bleached and unbleached papers, for writing and printing. In experiments with corn husks for paper-making, it was found that they were capable of producing a coarse fiber suitable for weaving; and in connection with the papers are specimens of the cloth, which resemble very coarse linen or canvas, and also the tow and yarn, with heavy oil-cloth prepared from the woven material.

The Paper Manufacturing Company, of New York, is here represented by several varieties of paper, from steam-blown cane, flax, hemp, and straw, as also sheathing felt from cane and shoddy wool.

J. Woodruff & Co., Quincy, Illinois, have paper from a native grass of that region, (*Spartina cynosuroides;*) and from Golden City, Colorado, are papers made from oat and wheat straw, and leaf pulp and paper from the *Yucca augustifolia.*

The United States consul at Newcastle-upon-Tyne, England, has sent some fine qualities of book, letter, and printing papers, made from the Esparto grass, *Stipa (Macrochloa) tenacissima;* and among papers from miscellaneous substances are those from okra, slough-grass, salt hay, ramie, *Agave Americana*, and the pressed stalks of the sorghum, or Chinese sugar-cane. A roll of Maguey paper, (*Agave Americana,*) from the city of Mexico, was presented by Dr. Schott.

The Chinese papers comprehend an assortment from bamboo, mulberry, straw, &c., also embossed and colored fancy papers and wall-hanging. Rolls of wood wall-papers, or veneer, are also on exhibition, from the maple, mahogany, ash, walnut, and cherry.

From this sketch of the classification of fibers and papers in the museum, it can be seen how useful such a collection may eventually be made, both to the grower and the manufacturer.

Turning to matters more purely agricultural, a very creditable display of the principal cereals of the country will be found, though by no means so complete and general an exhibition as could be desired. Appeals to State agricultural societies for co-operation and interchange of specimens have as yet met with no response, most of the specimens received being from individuals who have generously interested themselves to aid the effort to have the agriculture of the country, as well as the politics, represented at the national capital.

Many fine samples of wheat have been sent from Western States and Territories, especially from Montana, Colorado, California, and Oregon. The largest collection of corn (maize) from any one State was sent by Dr. J. A. Warder, from Ohio, but many superior specimens, both shelled and in the ear, are on exhibition from other localities, as also several varieties of rice, millet, and other small grains.

As a State, California, although one of the most distant, shows the greatest variety of products. The models of pears from that region are of great size and beauty; there are also samples of the wines, nuts, dried figs, raisins, spice and seeds, mammoth pine cones, cotton, flag, and silk cocoons. The top of the large table occupying the center of the

hall is made from the redwood (*Sequoia sempervirens*) of California, and is a single plank, twelve feet long by seven feet in width, which was sent to the Department a few years ago by Messrs. McPherson & Wetherbee, of San Francisco, California.

Opposite the case devoted to the cereals of this country is another filled with European and other foreign grain, mostly selected by United States Commissioner Beckwith at the "Exposition Universelle" in Paris, in 1867. These specimens have all been put in bottles, labeled, classified, and arranged, since the occupation of the new museum. The ten handsome cases of European grain, wheat, barley, rye, oats, &c., from Messrs. Vilmorin, Andrieux & Co., of Paris, are also exhibited, together with a valuable collection from the London World's Fair, of 1851, donated to the Department from the Smithsonian Institution.

The sorghum interest is represented by stalks and seeds of different varieties, as classified by the sorghum convention of 1864, and by sirups and sugars from various sources. Maple, cane, and beet-root sugars are also shown; the finest assortment of the latter being manufactured in France and sent by Mr. McChesney. Messrs. Gennert Brothers, of Chatsworth, Illinois, have also sent good specimens of beet-root sugar and samples of the desiccated or dried beet-root.

Small specimens of honey and the wild bees of Arizona have been presented by Dr. Palmer. The pure Italian bees and the stingless bee, (*Trigona*,) with the bee tree and comb of the latter from South America, are also on exhibition.

A variety of marls, guanos, and other fertilizers; salt, ochre, peat, coals, and petroleum oil rocks, with oils, dyes, and other manufactures therefrom, occupy appropriate places, and have full explanatory labels.

Among economic products are desiccated vegetables, starches, flours, farinas, materials for dyeing, gums, resins, oils, spices, coffees, and various other native, foreign, and tropical substances, for many of which, of great value and beauty, the museum is indebted to the Smithsonian Institution.

The Army Medical Museum, of Washington, has also presented an interesting collection of substances used as food, &c., by the North American Indians, and alcoholic specimens of insects.

Among the specimens of tobacco are some very fine samples raised from the seeds sent out by the Department; and also leaves, seeds, &c., of Latakia, yellow Turkish, and other tobaccos.

A great variety of miscellaneous articles and specimens of natural history not here enumerated will be found to have received due attention, and contribute their share to the general fund of information.

The collection of domestic poultry, pigeons, &c., has been much enlarged and improved by the purchase of several pairs of superior breeds, which have been handsomely prepared and mounted as type specimens of the pure breeds. There are still a few varieties lacking, however, to make the list complete, and it is hoped they will be procured during the coming year. In connection with these, may be mentioned a good collection of our native wild ducks, geese, &c., to show the difference of size between a bird, when wild and in a state of nature, and the same bird when domesticated and improved by a judicious selection of the proper pairs to breed from. Our native partridges, grouse, and other game birds are also shown, together with such foreign ones as can be acclimated and bred in this country. In the large case of native birds, each specimen is labeled to show its scientific and common English name, its food, habits, and whether injurious or beneficial to the farmer. The contents of the stomach are also preserved, when possible,

in small boxes, so as to show what particular insects are destroyed by certain species of insectivorous birds. References are also given on each label to standard works on ornithology, where further descriptions can be found if desired.

No additions have been made to the modeled fruits, no money having been appropriated for that purpose, and consequently many rare fruits and vegetable products received from different parts of the country have been lost. The fac simile fruits now on exhibition have been re-arranged and labeled since the occupation of the new building, and for the varieties they represent form a tolerably good list for the guidance of the pomologist; each specimen being accompanied by a label containing its name, synonyms, locality of growth, and reference to Downing's book on fruit, where its full history and quality may be found. When the means for modeling are provided it is proposed to procure from each State and Territory such fruits as are best adapted to that locality; to have them properly modeled in the Department, correctly labeled and classified; one set of the models to be retained in the museum, and the duplicates and matrices to be returned to State agricultural societies, to aid in the formation of similar cabinets throughout the country. In this connection, the receipt is acknowledged, with thanks, of a fine assortment of fruits, corn, and other grains, from Kansas, from Washington Territory, from Nebraska, and Arkansas. The fruits were kept on exhibition as long as they lasted, and the grains were placed in cases with appropriate labels.

The entomological collection, comprising especially North American insects, has been thoroughly examined, and will be classified and arranged in new boxes or drawers as soon as practicable. For want of a proper cabinet in which to exhibit them, they remain stored in the old boxes or on the shelves of the work-room, together with a very large and valuable collection of European, South American, and other foreign and tropical insects, most of which have been donated by the Smithsonian Institution and the Army Medical Museum. The specimens would add greatly to the utility, interest, and beauty of the museum if they could be exhibited.

The copperplate engravings representing the noxious or beneficial insects of North America have been largely increased during the past year, and now include the majority of those insects known and described by agricultural entomologists; showing them colored from life in the various stages of their transformations, with names, synonyms, and full references to note books, which have also been prepared, giving the names of the insects and food-plants in alphabetical order, with descriptions of their habits, changes, and locality, together with the various substances on which they feed. The object being to make this museum a complete repository of useful knowledge, no pains have been spared to make it worthy of the generous support of the public, for whose benefit it is designed.

The plan of having the various States represented by their products, as spoken of in a former report, has not yet been carried into effect, for want of proper cases; but it is still hoped that the utility of the design will induce a more generous liberality toward this division of the Department than it has heretofore enjoyed, or that the States themselves will take the matter in hand, in order to be properly represented by their agricultural products in the national capital.

TOWNEND GLOVER,
Entomologist.

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE CHEMIST.

SIR: I have the honor to submit the following report, indicating the nature of the work performed in the laboratory, and embodying such remarks as were thereby suggested, or called forth by the needs of agricultural science in the United States.

Embracing in its operations such variety of climate and agricultural interests so varied, the Department has a very extensive chemical correspondence, and a large number of analyses of agricultural products, as marls, clays, soils, peats, &c., have been made during the year, which, though of great value to the several localities demanding them, are devoid of public interest, and form, therefore, no part of this report. The number and nature of the analyses reported on here bears a small relation to those which have been actually made. Much information on technical arts relating to agriculture has been conveyed by correspondence, of which no mention is made.

SUMAC.

The following analyses of American sumac were made in the laboratory, with a view of determining the relative values of the native and the European growths. Sumac contains both coloring matter and tannin, and is used in dyeing and calico printing, as a substitute for nut-galls, for producing shades of gray color and for dyeing Turkey red; it is also used extensively for tanning the finer kinds of leather. Of the two uses the latter is the more important, and attention was chiefly directed to the amount of tannin. Wagner has determined the amount of tannin in European sumac, by the use of cinchonia as a test, as follows:

Sumac, 1st quality	16.50 per cent.
Sumac, 2d quality	13.00 per cent.

Gauhe (in Fresenius' Zeitschrift, 1864) gives as the average of six analyses of sumac 13 per cent. of tannin; and this may be looked upon as the average percentage of the great bulk of Mediterranean, although fine samples of Palermo will yield 22 and 24 per cent. of tannin.

1. Sample of tannin from J. D. Gordon, Girardstown, West Virginia:

Tannin	20.80
Vegetable fiber, extractive, and sand	79.20
	100.00

2. Sample from Jacob Ramsburg, Georgetown, District of Columbia:

Tannin	18.25
Vegetable fiber, &c	81.75
	100.00

3. Sample from W. H. Russell, Fredericksburg, Virginia:

Tannin	23.50
Vegetable fiber, &c	76.50
	100.00

4. Two samples from R. T. Knox Brothers, Fredericksburg, Virginia. (Average of both:)

Tannin	28.20
Vegetable fiber, &c	71.80
	100.00

These results were obtained by the use of Hammer's method of determining tannin, as described by Fresenius in his work on quantitative analysis. As the returns show a great richness in tannin in the American samples, which did not all appear of first quality, it proves our capability of competing with the best sumacs in the foreign markets. It is proposed to make a more extended examination of the growth of next year, to be recorded in the report of 1870.

WINES.

Numerous samples of wines have been analyzed during the year; in almost every instance, however, presenting no features of general interest. A very general want of precaution in closing the bottles causes much waste of valuable time in examining wines, perhaps originally of good quality, which, by secondary fermentation, have been so far ruined as to fail to represent the mode of treatment. Bottles should, in all cases, be closed by a long cork well soaked, gummed, or sealed, and tied, and the whole packed in sawdust or other suitable material. This neglect on the part of the manufacturer arises from a preconceived notion that, once bottled, no other change of moment occurs in the wine, produced by air or causes existing within the wine itself. No notion can be more erroneous. The changes which wine undergoes by keeping, or the beneficial changes which occur in it by age, are due to several causes. Very many have believed that in a complex liquid, such as the juice of the grape, with a constant, though partial, exposure to the air, changes must be continually going on which are due to slow oxidation. Others, again, have affirmed that mutual decomposition must occur in such a fluid by affinities between the principles present, without any aid from the oxidating influence of air; and some that both of these sources of change—that from within and that from catalytic oxidation from without—are necessary to account for all the phenomena which wine exhibits by age. It is well known that ethereal products are formed in wine by age, and there is no doubt that this does occur frequently, if not always, without the intervention of the external air; yet age is not the sole cause of etherification. The changes which new wine undergoes consist in: 1. Formation of a considerable deposit; 2. Loss of taste of new wine; 3. Change of color; 4. Development of bouquet. These changes it is now known may be produced after some weeks, though they hitherto required usually as many years. Exposure to the oxygen of the air will develop them all, but when produced, if still exposed to the air, other changes will follow. Thus, after storage in the cask to hasten oxidation, it becomes necessary to place the wine out of further contact with air by bottling, if it be desired to preserve the quality and flavor of the wine. In order to obtain a good wine cheaply both manufacturers and merchants have devoted much time and consideration to the preservation and the aging of wines. Appert, in a work entitled "*Traité des Conserves*," relates that in 1840, having sent to San Domingo two bottles of wine (of Beaune) which had been heated to 70° C. (158° F.) in a water bath, and having compared them on their return thence with a bottle of the same wine remaining at Havre, and with a

bottle stored in a cellar at the wine factory, neither of which had been heated, he found that the cellared bottle had still a fresh taste, the bottle at Havre had preserved its aroma, while the San Domingo bottle was superior to both in fine flavor and bouquet. In fact, in delicacy of taste it was apparently two years older than the Havre wine, and three years older than that cellared; and he (Appert) mentions the fact that this is a very simple mode of preserving wines. But little notice was taken of this experiment of Appert, probably because of the belief that the inventor of a method of preservation, no matter how good, would set it forth as suitable for the preservation of every solid and fluid, and thus the germ of a valuable process was overlooked by the discoverer and neglected by the public. This fact had been known, indeed, by the ancients, since the Cretans used to boil their wines which they intended for export beyond sea, in order to prevent alterations in them. Subsequently to Appert's time Vergnette Lamotte proved by additional trials the good effects of the employment of stove heat for preserving wines, when it did not exceed a temperature of 45° C. (113° F.) for five, ten, or fifteen days, or even two months. He remarks that the wines which bore this treatment best were the Spanish wines—Sherry, Madeira, Malaga—next the Hermitage and Bordelais wines; that the Burgundy wines were not benefited to any extent, and that it decolorized and rendered acid the other inferior wines of the country.

In vinous fermentation all the elements of the wine, succinic, acetic, phosphoric, tartaric, œnanthic, and other acids, glycerine, the alcohols, and the ethers present, may react upon each other; from the slow action of the acids upon the alcohols other ethers will arise; both common and amylic alcohol will produce their corresponding aldehydes by more or less complete oxidation, and subsequently in the bottle these changes will be carried to their last point and the full bouquet of the wine will be developed. Bechamp had pointed out that while oxygen was necessary to these changes, its action was not purely physical or chemical; it was not a direct action; and that young wine never becomes aged if it has been filtered while bottling. Vinous fermentation when complete is not the product of a single ferment; as the ferments vary so will be the resulting products, and the element of heat of the fermenting fluid will also influence the results; and while the final fermentation of the wine is due to the action of the alcoholic ferment, the final changes of bouquet and taste are due to a fermentation produced by the action of small organisms no larger than the smaller Bacteria, (objects wholly invisible to the naked eye,) and according to Bechamp the whole secret of aging wines and preventing them from spoiling depends for the future upon favoring the production of the special organisms which produce these special results.

Every year in France eight millions of hectolitres of wine, worth eighty to one hundred millions of francs, are lost on account of different diseases to which these wines are subject. They cannot be transported, as they spoil readily. Any method which offers a certainty of lessening this damage is a great boon. In order to test the value of heat the French minister of marine caused experiments to be carried on at Toulon on a large scale, the results of which have been the employment of the method of heating by many different forms of apparatus. The plan of heating wines suddenly up to 50° or 60° C., (140° F.,) however efficacious and easy of application on a small scale, is beset with difficulties of detail when it is attempted on large quantities of liquid, as, for instance, thousands of gallons. More than twenty different forms of apparatus are in use in France, all of them vaunted as savers of manual labor, and ad

mirable in their plan of excluding the injurious action of air from so large a mass of exposed liquid. Apparently the best of them is the apparatus of Terrel de Chenes, which he calls an "Œnotherm," or wine heater, and which consists of a boiler, a pump, and accessory apparatus. The boiler consists of a furnace surrounded by a water bath or jacket, which has a serpentine coil of pipes through which the wine passes and by which it is heated. These pipes, to the number of forty, and made of tin, have an interior diameter of .004 of a metre, and a length of two metres. They are separated from each other by half a centimetre. Thus every tube is completely surrounded by hot water, and a very large surface of wine is exposed to heat. The accessory apparatus consists of a pump for distributing the wine from the tank through the small pipes, and elastic tubing with screws and fittings. The whole œnotherm weighs two hundred and twenty-five kilog., is easy of transportation, and, like a small portable steam engine, is capable of being worked in any locality. The wine as it passes through the pipes is heated to a higher or lesser degree in proportion to the action of the pump. In thirty-three minutes five and a half hectolitres of wine can be driven into the pipes in the water bath after having been lifted up nearly fifteen feet from the wine vats to the boiler; in fifteen minutes more it is heated to 50° C. The cost of this apparatus, with the expense of heating 10,000 hectolitres of wine, is set down at 3,500 francs, against the ordinary wine-heating apparatus of Rossignol, with which similar work is done for 5,650 francs. An illustrative wood-cut of Terrel's apparatus is given in Barral's *Journal d'Agriculture Pratique*, 1869, vol. 2, p. 818.

It is generally admitted that the phenomena known as the aging of wines are due to oxidation of the liquor going on slowly, either in cask or in bottles. One of the changes which the wine undergoes is the deposition of saline matter, or an incrustation of small crystals deposited on the sides of the bottle. This change does not affect the flavor or value of the wine, and, indeed, renders it less liable to future change. Another change which wine may undergo is the deposition of red or brown coloring matters, the result of oxidation within the wine derived by the contact of oxygen of air contained in the liquor. This change, if not checked, may injure wines. A third and more serious change occurs when a sediment is deposited which is the result of internal fermentation, and is chiefly made up of various cryptogamic vegetations, to which M. Pasteur has affixed names. These ferments are the causes of diseases of wines. He and V. Lamotte call these little bodies *mycoderms*, and attribute the great losses in Burgundy wines in 1859 and 1861 to their action on the bottled wines. These mycodermic germs were in the wine in the cask before bottling off, and would have remained inert were it not for the oxygen in the air always present in most of fresh wine, and which supplied the pabulum for their enormous multiplication. While thus growing they produce the changes in wine known as mouldiness, ropiness, foxtail odor, acid taste, the escape of some bubbles of carbonic acid, and the extensive formation of acetate of potassa. A cold of twelve degrees Centigrade below the freezing point, the addition of alcohol, tannin, acids in general, sulphurous acid, sulphur in powder, and powdered rosin have an eminently preservative action in preventing the multiplication of these mycoderms. As the introduction of these foreign substances is apt to affect the taste of wines, the effect of stove heat was tried, and it was found that a heat of forty degrees Centigrade, according to V. Lamotte, would prevent the growth of the germs, and produce in the wine the first two changes mentioned above. The coloring matter of red wines is so extensively deposited at the end of a year

as to make them resemble Spanish wines, and shrunken mycoderms may be detected by the microscope in the deposit. In well bottled wines the change never proceeds to the third stage above described, owing to the fact that there is not oxygen sufficient to carry on the vitality of the mycoderms to the extent of acetification or putrefaction. Pasteur at first believed it necessary that a heat from sixty to one hundred degrees Centigrade in close vessels for one or two hours should be used to destroy the mycoderms. He recommended hot-air stoves, and by careful corking allowed sufficient dilation to occur. His experiments show that when new wine is submitted to a heat of fifty-five to sixty degrees Centigrade, (one hundred and thirty-one to one hundred and forty degrees Fahrenheit,) very favorable results are produced, giving a force of stability to the wine, which strengthening it with alcohol without heat never fully accomplished. When strengthened with two per cent. of alcohol the wine throws down within a fortnight a deposit which consists of much of the ferment of the wine, some of which ferment still contains living organisms, and the lesser portion of which has lost its vitality. The effect of heat is to destroy the vitality of all of these organized ferments, and thus to arrest fermentation and prevent the wine from proceeding to unfavorable changes.

The advantage of curing wines by heat is incontestable—an invention originally of Appert, and so admitted by Vergnette Lamotte, and Pasteur; but the former did not fully comprehend either its many advantages or its *modus operandi*. It is to Pasteur alone that the merit is due of having fully explained its action, and consequently of having furnished a certain rule for operating in all cases. The benefits derivable are unalterability of the wine, perfect preservation of its color, brilliant limpidity, absence of deposit or of adherent matters, constant superiority of the same wine when heated over that which is not, and less difficulty in preservation than with the non-heated wine. One of the conditions to be observed in the heating is that the wine must not be exposed to the air; the wine should be bottled beforehand. The Syndical Commission on wines of Paris made a report to the French Academy on this subject, dated 11th August, 1869. The proofs were by taste of those skilled in wines, and the vote was overwhelmingly large in favor of the heated wines. As a still further improvement in the treatment of wines to improve their quality generally, and to give to new wines the properties of old, Mr. R. D'Hereuse, of California, has made a new application, consisting of the introduction of air into the barrels or tanks of wine, by which, he asserts, the albuminous matters of the wine are destroyed by oxidation, and thus a great source of subsequent fermentation of the wine is removed. The apparatus recommended by Mr. D'Hereuse for this purpose is very simple, consisting of pipes of block tin or other metal not affected by the liquid, perforated with pin-hole apertures several inches apart near their termination, which is in the form of a disc or coil at the bottom of the wine vessel. This perforated pipe for the admission of the air is connected by an upright metal pipe or a rubber hose over the rim of the tank or barrel to the main air pipe, and thence to the air-supply pump worked by hand or machinery; these pipes may be connected by screw couplings, rubber joints, or other ready means. Before driving air through the must or vinous liquid, the latter is to be warmed quickly to sixty-two or sixty-four degrees Fahrenheit, if it have not been heated previously in the gathering tank from the press, which latter method is recommended as preferable. When the tanks are thus filled and warmed, the air is to be driven in with considerable force; the apertures of exit being very

minute, the air is finely divided as it passes through the must, and readily oxidizes all nitrogenous matter with which it comes in contact. When the air is driven in from ten to fifteen minutes, effervescence or foaming commences and gradually augments, lasting for six to eight hours at a time; the air is then driven in more moderately—(say for five minutes three times a day.) If the temperature of tho room is not allowed to fall below sixty degrees Fahrenheit during the aeration, the whole operation will be completed in five days after the foaming up. If the must is very sweet a few days' more treatment is required; this is needed in order to decompose the sugar which is in excess, for although the first action of oxidation is expended upon the albuminous matters of the must, yet these principles cannot be oxidized and removed without the saccharine matter which has escaped alcoholization being also decomposed, as in ordinary vinous fermentation, and terminating in the formation of alcohol, water, and carbonic acid; and it is the escape of this latter gas which causes the boiling up in the must. Hence it is that the amount of aeration of wine depends to a very great extent upon the amount of sugar left in the must after the alcoholic fermentation, and by this process of aeration Mr. D'Hereuse advances fresh wines to the condition of dry and old wines. The adjustment of the temperature of the must vessel is very important, for if the must be too cold upper fermentation is not set up, and the result is the formation of sweet wine, the gluten in solution only being acted upon and the sugar not decomposed; but when a temperature between 60° and 65° Fahrenheit is kept up in the vat, then upper fermentation is set up, and if the aeration be kept up, the sugar is catalysed and disappears, and dry wines are the result. Thus a few months under this new method of treatment suffice to age wines, render them dry, and bring them into that desirable condition of flavor, aromatic bouquet, and full fermentation which are so agreeable in properly handled wines. For this method of improvement Mr. D'Hereuse took a patent in this country, dated August 6, 1867. Samples of wine so treated were forwarded in September, 1869, to this Department by the patentee for examination. Affidavits and other satisfactory evidence were also forwarded to prove the age of the wine, which was of the vintage of 1868. This wine, on analysis, yielded the following results:

	Per cent.
Absolute alcohol, (by weight)	9.76
Absolute alcohol, (by volume)	12.18
=24+% proof spirits.	
Grape sugar	0.05
Acid, (calculated as dry tartaric)	1.70
Extract	1.84
Ash	0.26

Specific gravity of wine, .9906.

It contained tannic and gallic acids, was highly acid to the taste, and of light color. Probably the latter acid has been formed at the expense of the extract by aeration.

Before closing this subject of the amelioration of wine, it may be well to allude to Scoutetten's method, lately brought to notice, which consists in passing electric currents through wines. The current is developed by a pile having conducting wires of brass with platinum electrodes, which are plunged in the wine vessel. The circuit is kept up constantly for a week or a month. The wine is said to be greatly improved in flavor. The method has not yet been applied in practice.

SOILS.

But few soils have been examined, and only in those instances which appeared to call for special investigation. A few analyses made of Ohio soils are appended. Those soils which were submitted for analysis, and were either supposed to be lacking in some important mineral ingredient or to contain some element absolutely prejudicial to plant growth, are the only ones in which a chemical examination could be expected to yield any assistance to the cultivator. Soil is a substance of great complexity, containing often as many as twenty different chemical substances, the majority in very small proportion. There is, therefore, not only a great variety in chemical constitution, but a great difference in the physical condition or rate of decomposition of the minerals of which the soil is made up. To estimate the fertility of any soil, this last fact must be borne in mind, for it is not merely what substances are present in a soil which render it a productive one, but, also, whether they are easily separated or dissolved, and thus absorbed by plants. This, an analysis as commonly conducted does not always tell. Two soils may yield on analysis precisely the same constituents, yet one may, in practice, be fertile and the other barren. The substances useful to plants must be in such a state that they can be absorbed by the spongioles of the plant; but we do not accurately know whether it is necessary that they should be dissolved by water, and thus enter the root, or whether the root is an active agent, working on the soil and directly appropriating what is needed. Experiment is needed to determine this point, for, partly from ignorance on this head, we are unable to shape our analysis to a useful end. Indeed, our analyses of soil, however strictly correct they may be in chemical method, are of little scientific value, and are of even less use to the agriculturist. Nor is it likely that soil analysis will aid the practical farmer until a vast number of minute analyses have been made with the view of determining the influence which living organic tissue can exert upon the mineral elements present, and thus a knowledge be established of some of the guiding principles upon which the various compounds of a soil are acted upon by the plant, and in turn react on it. Further statements on this subject may be found in the Report for 1866, page 46.

The following is a copy of the analysis of six soils sent to the Department by Isaac Welch, of Belmont County, Ohio:

No. 1. Surface soil, 18 inches deep, No. 2. Subsoil,	Bottom land, Captina Creek.
No. 3. Surface soil, 12 inches deep, No. 4. Subsoil,	County seat, St. Clairsville; upland.
No. 5. Surface soil, No. 6. Subsoil,	Barnsville; upland.

These soils, as sent, were nearly uniform in degree of fineness. From their appearance they might have been taken from one locality. The analysis was made with a view to determine what might be the immediate richness, *i. e.*, what amount and variety of mineral and organic ingredients they were capable of yielding to plants within a few years. The samples do not appear to have been sent as gathered, sifting, or some other mode of separating the associated rocks and vegetable debris, having possibly been resorted to.

		No. 1.	No. 2.	No. 3.
Water		2.33	2.18	2.26
Organic matter		5.73	3.72	7.74
Matters soluble in water,	Lime	0.44	0.80	0.54
	Magnesia	0.047	0.50	0.003
	Iron, protoxide	0.002	0.005	0.007
	Sulphuric acid	0.53	1.03	0.72
	Phosphoric acid	0.001	trace.	0.002
	Chlorine	trace.	trace.	none.
Matters soluble in acid,	Peroxide of iron and alumina	10.96	11.73	8.32
	Lime	1.10	2.07	1.01
	Magnesia	0.07	0.87	2.33
	Phosphoric acid	0.005	0.01	0.03
	Alkalies	0.87	1.00	0.92
	Sulphuric acid	trace.	0.20	1.62
Silica and earthy silicates		77.915	75.885	74.498
		100.00	100.00	100.00
No. 1 contained soluble humus, (acid,) 0.93; No. 3, 0.79.				
Specific gravity, (air weighed)		1.555	1.61684	1.4643
Absorptive power of 100 pounds soil expressed in pounds of water		54 lbs.	46.5 lbs.	60.5 lbs.
Reaction		acid.	neutral.	acid.

		No. 4.	No. 5.	No. 6.
Water		2.06	1.83	2.22
Organic matter		3.34	6.57	4.40
Matters soluble in water.	Lime	0.65	0.294	0.69
	Magnesia	0.47	0.015	0.023
	Protoxide of iron	0.01	0.011	....
	Phosphoric acid	0.98	trace.	....
	Sulphuric acid	0.001	0.30	0.82
	Chlorine	0.90	trace.	....
Matters soluble in acid.	Peroxide of iron and alumina	8.69	7.98	6.81
	Lime	2.66	0.61	2.14
	Magnesia	1.734	0.42	3.32
	Phosphoric acid	0.008	0.01	0.087
	Sulphuric acid	0.30	0.87	2.00
	Alkalies	1.99	traces.	0.027
Silica and earthy salts insoluble in weak acid		76.212	81.09	77.463
		100.00	100.00	100.00
No. 4 contained only traces of acid humus				
Specific gravity, (air weighed)		1.5962	1.5411	1.6369
Absorptive power per 100 pounds soil expressed in pounds of water		40.5 lbs.	50.5	45.5
Reaction		faintly alkaline	strongly acid.	faintly acid.

MARLS.

In the early part of the year a number of analyses of marl were made, including under this head, as well, the later tertiary beds of South Carolina, the full analyses of which were given in the report of last year, and also the cretaceous beds which there represent the green sand of New Jersey. The Carolina phosphate bed yielded respectively 56, 55, and 64 per cent. of tribasic phosphate of lime, besides phosphates of iron and alumina varying from 6 to 10 per cent., along with soluble saline matter equal to 1.5 per cent. An analysis of marl of the upper tertiary beds of Georgia is subjoined:

Marl from Savannah, Georgia, William Schley.

Water	1.04
Organic matter	1.90
Insoluble silica	35.21
Peroxide of iron and alumina	7.35
Lime	29.80
Carbonic acid	22.35
Sulphuric acid	1.93
Phosphoric acid	0.03
Chloride of sodium	0.39
Potass	trace.
	100.00

Samples of marls forwarded from Middlesex County, Virginia, by O. N. Bryan, Marshall Hall Post Office, Maryland, have been examined and with one exception have been found valuable marls, yielding evident quantities of phosphoric acid, existing chiefly as phosphate of iron. Considering how valuable such beds are in their vicinity, both as top dressings and as materials for compost, I can only repeat the recommendation made in last year's report, that it would much benefit the agriculture of Virginia if the State would expend a small sum in carrying out a geological exploration which would lead to the development of these beds of marl in the eastern counties.

Before leaving the subject of the marls of the Atlantic coast, it is well to call attention to a source of manure not much used in this country, and yet yielding relatively large amounts of alkaline salts and phosphates. I allude to the sea-weeds which are washed ashore in large quantities along the coasts, not only of the ocean, but also of the deep bays which run up inland, and in the channels between the islands of the coast. Some of the species of sea-weeds are richer in ash than others. The most generally diffused species, the *Fucus*, or bladder wrecks, appear to have the most powerful selecting power and to withdraw large amounts of saline and earthly matters from the sea water. Pereira has made an analysis of the *Fucus vesiculosus*, and found the ash of that plant to be made up as follows:

Potash	11.96	Oxide of iron	0.95
Soda	12.25	Sulphuric acid	24.62
Lime	10.92	Silica	4.06
Magnesia	0.53		
Common salt	19.82	Total	100.00
Iodide of sodium	0.25		
Phosphate of iron } Phosphate of lime }	5.64		

Fresh weed usually yields 16 per cent. of ash, or 320 pounds to the ton of weed; and each ton of ash would yield 18 pounds of phosphates, iron and lime; 38 pounds of potash, and 33 pounds of plaster or gypsum, besides common salt and sulphate of magnesia, making a total of 164 pounds of valuable saline matter, or more than one-half of the whole ash. Valuable as are many of these ingredients to plants, the application of sea-weed as a manure has some remarkable properties which do not appear to be explained by the analysis. The weeds are largely used in the west of Ireland, and a price paid for them far beyond their value as indicated by chemical composition. As a manure for potatoes they are hardly excelled. Along the coast of Cornwall, England, they are successfully used for grass, cereals, and roots, and for apple orchards when spread round each tree. The broccoli which is cultivated round Penzance in hundreds of acres knows no other manure. Dr. Anderson, of Scotland, has also made an analysis of this sea-weed in which the potash amounted to 20 per cent., and soda to 6 per cent., while the phosphoric acid amounted to 2.14; he also made an analysis of this and other weeds, as *Fucus nodosus* and *Laminaria digitata*, which are generally found together, with the following result:

Water	77.31	Ash	8.98
Albuminous compounds	3.32		
Fiber	10.39	Total	100.00
		Nitrogen	0.53

The ash consisted of—

Peroxide of iron	2.35	Phosphoric acid	4.59
Lime	18.15	Sulphuric acid	6.22
Magnesia	6.48	Carbonic acid	13.58
Potash	12.77	Silicic acid	3.00
Chloride of potassium	9.10		
Iodide of potassium	1.68	Total	100.00
Chloride of sodium	22.08		

From ten to twenty tons per acre is the usual quantity applied. They are manures which act very rapidly, softening and decomposing in the soil so quickly that their effects are confined altogether to the special crop to which they are applied. They may be applied alone or composted with lime and earth. Any of the shell marls which are found so frequently along the coast and the tide-water region would be most valuable compost material.

The above analysis represents the composition of the fresh weed; but when it has lain on the ground for some time, either alone or in compost, it parts with a considerable quantity of water, reducing that element to less than one-half or not more than 40 per cent. of water, which of course would render a given weight much more valuable.

Several analyses of mineral and well waters have been made which, being of no public interest, are here omitted. One, however, is worthy of note as involving some scientific interest, consequent on the application of the spectroscope; the water was from the heights of Georgetown, D. C., from the residence of Judge Fisher, the composition of which was as follows:

	Grains.
Solid matter per gallon	77
Viz:	
Carbonate of lime	28
Carbonate of magnesia	trace.
Sulphates of lime and magnesia	7
Chlorides of sodium and potassa	42
Iron as proto-carbonate	trace.

This water was of usual color, contained no organic matter, and presented a very faint alkaline reaction. Examined by the spectroscope the residue from evaporation gave the lines of calcium, sodium, potassium, and faint traces of rubidium.

NATURAL FERTILIZERS.

Some samples of guano from Aves Island, in the Caribbean Sea, have been examined. They belong to the class of phosphatic guanos, and their chemical composition is subjoined. The organic matter has been almost completely weathered out of these specimens, the average yield of ammonia being below one per cent. The alkaline salts remain nearly at the same figure as in the ammoniacal guanos, and the introduction of carbonate of lime brings the samples more nearly into relation with inferior varieties of Bolivian.

	Las Roques.	Quito Sueno, Aves Island.	Aves Island.
Moisture	4.50	3.00	3.40
Organic matter containing ammonia	15.80	17.80	15.2
Mineral matters	79.70	79.20	81.40
Total	100.00	100.00	100.00

COMPOSITION OF MINERAL MATTERS OF QUITO SUENO.

Phosphate of lime	56.60
Carbonate of lime	15.60
Alkaline salts	6.30
Insoluble sand, &c	1.29
	79.70

	Quito Sueno.	San Pedro Keys.
Water	2.30	2.45
Organic matter yielding ammonia	5.35	6.55
Sand, &c	1.50	1.00
Carbonate of lime	6.25	10.00
Sulphate of lime	2.97	2.90
Phosphate of lime	53.00	64.00
Alumina, iron oxide, chlorides, &c	28.63	11.00
	100.00	100.00

SWEET POTATO.

In the year 1868 C. K. Marshall, of Vicksburg, Mississippi, forwarded to this Department specimens of sweet potato, dried, and also some converted into meal. In June, 1869, additional samples were forwarded with the request to have them examined in the laboratory. The specimens, both sliced tuber and flour, were well prepared and preserved, had undergone no fermentation, were white, the tuber slices covered with thin white powder (starch grains) and on cracking the slice across the center had, in few instances, altered their color. The meal had a slight yellow brown tinge. The following is the result of the analysis:

	No. 1.	No. 2.
Moisture removed at 212°	6	7.90
Organic matter	89	88.80
Ash	3	3.30
	100	100.00

Average of two analyses:

Moisture	7.95
Organic matter	88.90
Ash	3.15
	100.00

Organic matter = 89.

Cellulose	6.750
Starch	65.290
Albumen	1.214
Sugar	14.830
Fat	.810
	88.894

Ash = 3.

Soluble in water, consisting chiefly of carbonate and sulphate of potass	.215
Insoluble in water, consisting of phosphates of lime and magnesia, calcium carbonate and silica	2.785
	3.000

If the normal amount of water present in the fresh tuber be rated from 65 to 67 per cent. the constitution of the recent potato would stand thus:

Moisture		65.96
Organic matter:		
Cellulose	2.50	
Starch	24.22	
Albumen	.45	
Sugar	5.50	
Fat	.30	
		32.97
Ash		1.07
		100.00

An analysis of this plant was made several years ago by Einhoff, (Ure's Dictionary, Am. ed., art. *sweet potato*,) the result of which was as follows:

Fibrin	8.2
Starch	15.1
Vegetable albumen	.8
Gum	...
Acid salts	...
Water	74.3
	98.4

A proximate analysis by Henry gives more minute details, (Watt's Dictionary of Chemistry, art. *batatas edulis.*)

Starch	13.3
Albumen	.9
Sugar	3.3
Fat	1.1
Woody fibre	6.8
Malic and phosphoric acids	1.4
Volatile poisonous matter	.5
Water	73.0
	100.3

Herapath records his analysis of this plant (Watt's *ibidem*) as follows:

Water	66.7
Dray organic matter	31.8
Ash	1.5
	100.0

Ash in 100 parts:

Soluble.	
Carbonic acid	7.1
Sulphuric acid	0.9
Phosphoric acid	29.3
Potash	12.4
Chloride of sodium	11.4
Insoluble.	
Carbonic acid	6.2
Phosphoric acid	7.1
Lime	12.0
Magnesia	1.4
Oxide of iron	1.3
Silicia	2.0

No fermentation of any kind appears to have been set up in the potato during or since the act of drying; the vegetable acids are quite readily distinguishable. The grains of starch are irregularly rounded and smaller even than those of wheat starch. This capability of being dried without alteration is a feature of great importance, as this material can be a source of food for cattle during the winter months, and, indeed, during times of scarcity might be used by man. Another point of interest concerning this root is the large amount of sugar which it yields in the dried state—over fourteen per cent. This sugar is altogether in the form of cane sugar; if the flour be mixed with cold water no glucose can be detected in it, and if the dialysing fluid be not heated above 100° Fahrenheit no glucose is afforded; when boiled it begins to appear, and gradually augments. On account of the abundance of the sugar contents, and its condition as cane sugar, this tuber might possibly become a source of sugar manufacture.

In the Report for 1867, (page 57,) I recommended the establishment, in conjunction with the laboratory, of a collection of geological specimens illustrating the mineralogical and economic geology of the United States. I have the pleasure to report some progress toward attaining this desideratum, a small collection having been formed which will no doubt be enlarged by donations made from desirable localities throughout the country.

I would again call attention to one means by which the laboratory could be made a valuable instrument for advancing our knowledge of vegetable physiology and practical agriculture, namely, by the connection of a small experimental garden, wherein certain plants could be grown under special conditions, and examinations made weekly or daily in the laboratory. By this close connection of the laboratory and the garden the science of agriculture might be advanced, and thus the Department would be legitimately carrying out one of its important functions, by acquiring useful information on subjects connected with agriculture. A few acres of ground would be ample for this object, and I respectfully press the adoption and carrying out of this plan.

As anything which impedes the cultivation of the soil, or the supplying to plants their needful food, is a direct tax on agriculture and a bar to its improvement, there can be no doubt that the tariff duty on importation of certain salts, useful to agriculture, must be so classed. Nitrate of soda is a salt of exceeding value in the manufacture of composts, the duty on which amounts to two and a half cents per pound, while the price of the salt in New York is four cents per pound. It would be a benefit to agriculture if this tax were diminished or removed altogether.

The adulteration of feed stuffs and manures is a subject which has attracted the attention of both agriculturists and chemists within the past few years; and as the manufacture of composts and manures has become a merchantable transaction on a very extensive scale, assuming even gigantic proportions, so is the fraudulent treatment of natural manures, and the impositions practiced in the sale of artificial manures, greatly on the increase. There is a growing tendency among farmers to give up the collection of materials for home composts and manures at the suitable season, and to enlarge their purchase and increase their trust in the manures furnished by the city salesman, whose only object in furnishing a strictly valuable manure is the desire to preserve the good name of his establishment. As this restraint operates very unequally on different manufacturers, the result is that the majority of fertilizers are far below the standard of worth which they profess to at-

tain; and although sold with perhaps a certified analysis attached, no trust can be placed in such certificate, because there is no evidence that such analysis was made for this special manure, and it is well known to be a fashion of manufacturers and salesmen to get one analysis made of a good cargo or brand and under its certified value to introduce half a dozen inferior brands. One analysis has before now been frequently used to sell a number of cargoes, and thus chemical analysis grows into disrepute among farmers. Yet it is by sale upon chemical analysis that the latter can ever hope to escape imposition. What is needed is that when the full market price is given for a manure, (and no farmer should ever buy a cheap manure, no matter under how tempting a guise it may be offered,) that he obtains a full equivalent therefor; to attain this end he should (1) buy of respectable dealers only, and (2) purchase on analysis only. In regard to this last particular it is proper not merely that the merchant should hand the purchaser a copy of a chemist's certificate, (which, as stated above, may be deceptive,) but that the manure should yield such percentage as stated to be proved by analysis made by direction of the purchaser, and the manufacturer or salesman should guarantee his manure to stand such test. Most of these cases of purchase may be sufficiently protected by such a guarantee. If a farmer wishes to buy bone dust, a written guarantee that the bone dust is genuine is abundant protection to the buyer. In purchasing guano, Professor Voelcker, of Cirencester College, recommends to deal, if possible, with the accredited agent of the Peruvian government; if not, to obtain a guarantee that the article is Peruvian government guano, first quality; no analyses are required for these. In buying nitrate of soda or sulphate of ammonia, buy according to the percentage scale of the valuable material; thus good samples of nitrate of soda ought to yield 93 to 95 per cent. of nitrate; sulphate of ammonia is bought according to the percentage of ammonia; good samples yielding 22 to 24 per cent. These salts sell at certain rates in New York and other commercial centers, and the price there regulates the trade. As the quality of the article varies, these salts should be bought on guarantees of reaching a certain percentage. It may be objected to this recommendation that it is very good for the purchaser on the large scale, but that for the small farmer, or he who purchases moderately, it is impossible for him to follow any such plan; for such trifling quantities manufacturers or salesmen would give no guarantee, and farmers could not afford to have analyses made. This objection has force so long as the agricultural community continue to make their purchases in the present way of every farmer purchasing his own lot of one, two, or three hundred-weight of guano or other fertilizer; but let farmers adopt the association principle and they can at once have a guarantee, and rest confident that their money has been profitably laid out. Let ten or twenty (or more) unite to purchase all the manure they require in one lot, as so many tons of guano, of bone dust, superphosphate, so many hundred-weight of salt, nitrate of soda, sulphate of potash or ammonia, and then the merchant will supply them with a guarantee. Notify him that the fertilizers will be analyzed on delivery, and returned if not corresponding to his sale statements. Now in every city, county town, or large town there will, in all probability, be found some one capable of making a chemical analysis of sufficient accuracy to report upon the value of the manures purchased. Some apothecary, a graduate of a college of pharmacy, may be found capable of doing this, or some young physician, whose tastes run in the pursuit of the exact sciences. For a small compensation the articles forwarded by the merchant may be examined and reported on, and the

expense, divided among the associated farmers, would be but a trifling tax on the purchaser, for which he would receive the pleasing assurance that his purchase was what it purported to be, or he would be saved from throwing his money away on a worthless compound. When those who sell fertilizers know that such protective societies are established, there will be less imposition, because its detection becomes so immediate.

There is a great advantage in farmers buying manures on a large scale; the price is lower, and the manure more uniform and exact. A good manufacturer may make a manure in good faith, produce a valuable article, and sell it on analysis. He makes, say, five hundred or a thousand tons of it, and sells the whole. It is found to work well, and is rapidly sold off. The demand still comes, and he sets about to make more. He purchases up all the raw material in the market; needs more; purchases a new lot, possibly inferior. An article is run out of the market, and the manufacturer endeavors to supply its place with the next best article, and thus, perhaps, with the best intentions, a second lot of fertilizer is made, really inferior to the first, but which is sold as of the same brand, and has appended to it the certificate of analysis belonging to the first lot. Now, when the farmer purchases some of this second lot, he suffers; if a new purchaser, being led to buy on the good report of the first lot, he is disappointed; both of which results would have been avoided if early in the spring the farmer had calculated how much artificial fertilizer he needed, and bought it all at once *of the same lot.* This is the only method by which the agricultural community can protect itself against the impositions of trade, and it is strongly recommended for their adoption.

THOMAS ANTISELL, M. D.,
Chemist

Hon. HORACE CAPRON,
Commissioner.

REPORT OF THE SUPERINTENDENT OF GARDENS AND GROUNDS.

SIR: I have the honor to submit the following notes upon the operations undertaken in the gardens and grounds of the Department, with conclusions reached from experiments therein.

RASPBERRY FROM JAPAN.

In March, 1864, Thomas Hogg, of New York, at that time residing at Kanagawa, Japan, sent to the Department a collection of seeds, among which was a package labeled as follows: "A native rubus which grows wild on the surrounding hills. The fruit in its season is brought plentifully to market. Its flavor is rather insipid; but when fully ripe and eaten with sugar, is palatable; color, yellow." These seeds were sown as soon as received. They vegetated freely, and in due time the young plants were transferred to a border in the garden.

They made a very luxuriant growth, which was killed to the surface during the following winter. For three successive seasons the result was the same—a good growth was made during summer, but it was killed down by frost during winter. Last winter proving to be less

severe, the plants withstood the cold and flowered and fruited profusely when the season arrived.

The fruit proved to be exactly as described by Mr. Hogg, an insipid berry of a most beautiful, transparent yellow color, but of no value to us, unless its earliness may give it merits in climates favorable to its growth. The fruit ripened two weeks earlier than the Black Cap raspberry.

STRAWBERRIES.

A remarkably large number of new varieties of strawberries has been introduced during the last few years; it is also remarkable that few of them are equal in value to the older varieties. This tendency to flood the country with kinds of mediocre merit is adverse to the best interests of fruit culture, entails heavy losses in the aggregate, and sadly disappoints many enthusiastic beginners who have not learned that pomological descriptions, although exceedingly attractive, have not reached the accuracy of an exact science, truthful portraiture giving way, in most cases, to poetical fancy.

Among the newer varieties that have not proved of much value are Gloede's New Pine, Ballard's Seedling, Stinger, Laurella, Naomi, General Meade, General Sheridan, General Grant, General Scott, General Sherman, Haquin, Higby's Everbearing, Globe, Haller's Prolific, Prince of Wales, Ornament of the Tables, Lorio, Durand's Seedling, Bonté de St. Julian, Premier, Champion of Richmond, Gloede's Perpetual Pine, Monstreuse de Robbins, and Dr. Nicaise.

The following varieties are, in general, of a higher grade of excellence than the preceding, and some of them may, upon further trial, enter into the list of standard varieties: Leed's Prolific, Coppick, Belle de Bordelaise, Napoleon III, Nicanor, Charles Downing, Welcome, Boyden's No. 30, Lady of the Lake, Colfax, Hero, and Laura.

The earliest variety is that named Welcome, a fruit of fair size and prolific for a very early kind. Coppick ripens next, and is very productive, but third-rate as to flavor; but the flavor of strawberries depends so much upon climate, locality, soil, and other influences, as to destroy uniformity even in the same variety. Belle de Bordelaise is a large hautbois of fine flavor. Lady of the Lake is quite productive, but deficient in size and quality. The Charles Downing is of excellent promise, and the same may be said of the Colfax and Napoleon III.

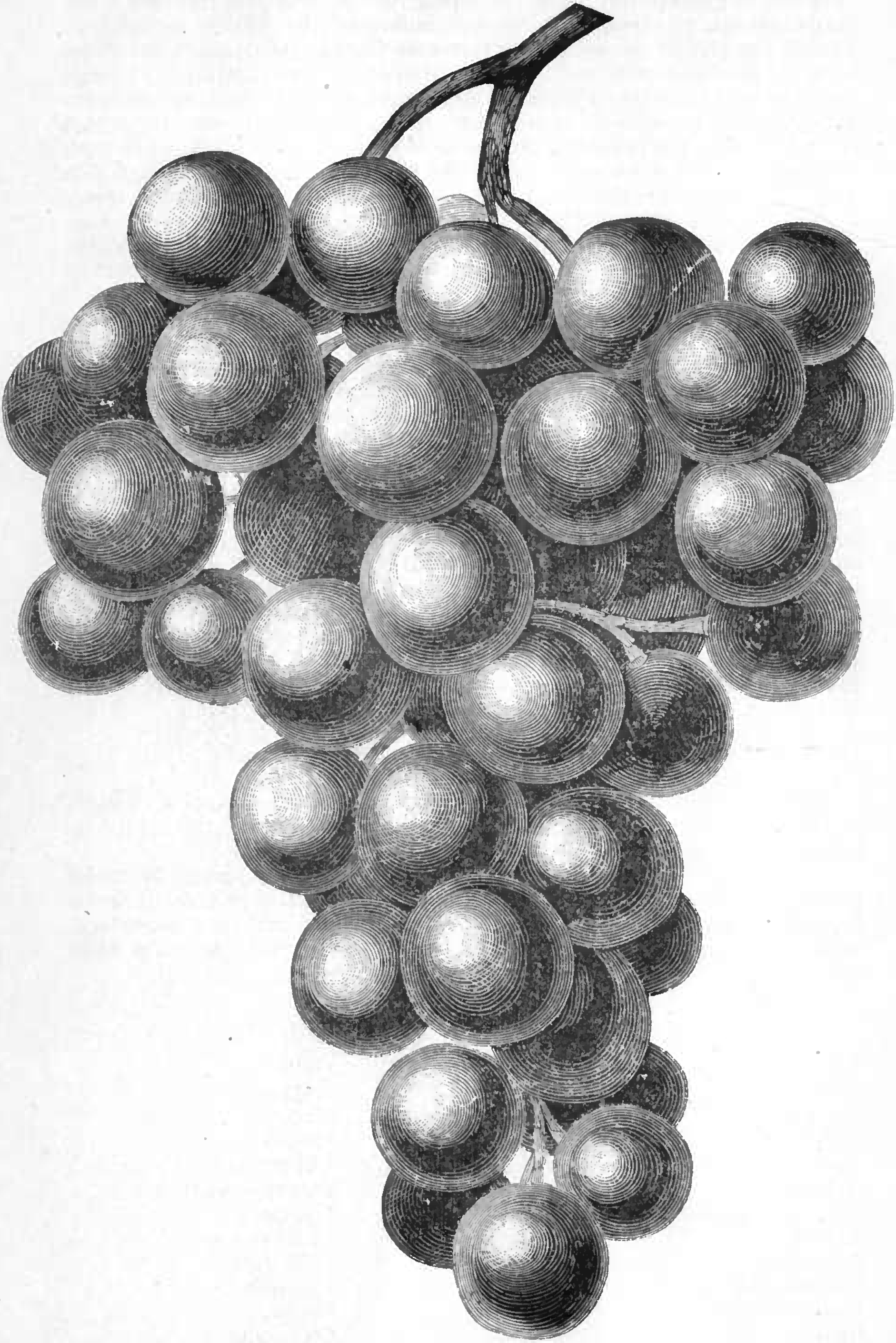
Among older varieties, Wilson's Albany still maintains a high position as a hardy, productive sort. Triomphe de Gand and Jucunda are among the finest; but, like all other foreign varieties, they require to be grown on a strong loam, or even a clayey soil, deeply cultivated and regularly worked or mulched during summer; in light or in hard compact soils, they will suffer very severely in dry weather. They are always most vigorous in young plantations; consequently frequent renewal is advantageous. The same treatment is required by the Agriculturist, a variety that produces fruit of the largest size on young plants, but degenerates rapidly if not renewed.

COVERED GRAPE TRELLIS.

Inquiry is frequently made relative to the efficiency of the covered grape trellis, described in the report for 1861, and its effect as a preventive of mildew and rot.

A trellis of this kind was erected in the garden early in the spring of 1863, and has proved valuable, enabling us to test the qualities of many

PLATE II.



VITIS LABRUSCA—VARIETY, CONCORD.

varieties of grapes that failed to ripen on the common trellises a few yards distant, on account of the destruction of the foliage by mildew. The philosophy of the action of protection in this particular case seems to be its tendency to arrest radiation of heat, thus protecting the foliage from the cooling action of night temperatures, which in turn prevents condensation of atmospheric moisture on the leaves, thereby checking, to a certain extent, the predisposing cause of mildew. In experiments with registering thermometers, it was found that, during clear, still nights in July, an exposed thermometer would mark from six to ten degrees lower than that under the cover, the foliage being thus kept warmer and, in consequence, dryer, on the protected plants. This also would seem to give a reason for the earlier maturity of the fruit, which has been observed to result from protection.

The best grape climates in this country are those of greatest immunity from dews, and it has been proved beyond a doubt that protection from dew will enable many varieties of the grape to mature, which otherwise cannot be successfully grown in ungenial locations.

These covered trellises do not seem to have any decided effect in preventing rot in the berry, that disease proceeding from the soil rather than from atmospheric influences.

An alteration has been made in the mode of constructing these protecting trellises, which promises results equal to those produced by the board coverings. A strip of wood about three feet in length is fastened on the top of the trellis posts, projecting equally distant on both sides, to which wires are secured, so as to form a projecting strand. A wire is also stretched and fastened along the center on the top of the posts, and in a line with them. On these top wires, grapes of the hardier varieties are trained, such as Ives, Concord, Clinton, &c. The foliage of these forms a protecting canopy, under which the kinds with more tender foliage can be grown.

CLASSIFICATION OF GRAPES.

A classification of native grapes, and those under cultivation as such, has long been desired. The following arrangement is offered as a contribution to this end:

SECTION 1. *Vitis labrusca, Northern Fox grape.*—Common in moist grounds, north and west; leaves and young shoots very cottony, even the adult leaves retaining the cottony wool underneath, the lobes separated by roundish sinuses; fruit large, with a tough musky pulp when wild, dark purple or amber color, in compact clusters. (Gray.)

Varieties.

Adirondack.	Barnes.	Catawba.
Anna.	Bland.	Cuyahoga.
Alexander.	Brackett's Seedling.	Cheowa.
Aiken.	Black Hawk.	Camden.
Albino.	Bates.	Coppermine.
Arkansas.	Bogue's Eureka.	Canby's August.
August Pioneer.	Black King.	Charlotte.
Arrott.	Blackstone.	Charter Oak.
Amanda.	Berks.	Chillicothe.
Blood's Black.	Concord.	Cloanthe.
Blood's White.	Cassidy.	Coriel.
Brown.	Creveling.	Cuyarano.

Cottage.
Carter.
Diller.
Dana.
Diana.
Detroit.
Dracut Amber.
Eva.
Elizabeth.
Elmira.
Ewing's.
Fancher.
Framingham.
Flora.
Garrigues.
Graham.
Greverson.
Hamill's Seedling.
Hudson.
Hartford Prolific.
Howell.
Hyde's Eliza.
Hattie.
Hine.
Henshaw.
Hooker.
Isabella.
Israella.
Iona.
Ives.
Kingsessing.
Keuka.
Kilvington.
Knob Mountain.
Little Giant.
Laura,
Logan.
Lydia.
Louisa.
Loomis's Honey
Lorain.
Lyman.
Montour.
Mary.
Modena.
Maxatawny. (?)
Manhattan.
Martha.
Maguire.
Massachusetts White.
Murdock.
Marion.
McLean.
Mary Ann.
Mead's Seedling.
Miles.
Miner's Seedling.
Mottled.
Macedonia.
Mount Lebanon.
McNeil.
McCowan.
North America.
Northern Muscadine.
NorthCarolina Seedling.
Nonantum.
Perkins.
Powell.
Poeschel's Mammoth.
Paxton.
Pollock.
Rachel.
Rebecca.
Red Shepherd.
Rentz.
Saluda.
St. Catherine.
Sage.
Saratoga.
Sanbornton.
Shurtleff's Seedling.
To Kalon.
Telegraph.
Underhill.
Union Village.
Urbana.
Una.
Wilmington. (?)

SECTION 2. *Vitis æstivalis, Summer grape.*—Common north and south; leaves green above, and with loose cobwebby down underneath; the lobes with roundish, open sinuses; clusters slender; fruit smaller and earlier than *V. labrusca;* black, with a bloom; pleasant. (Gray.)

Varieties.

Alvey.
Baldwin's Lenoir.
Baxter. (?)
Cunningham.
Cynthiana.
Devereux.
Elsingburgh.
Gassman.
Herbemont.
Hermann.
Harris.
Lenoir.
Lincoln.
Long.
Norton's Virginia.
Newport.
Old House.
Ohio.
Pauline.
Purple Favorite.
Warren.

SECTION 3. *Vitis cordifolia, Frost grape.*—Common on banks and streams; leaves never cottony; green both sides; thin; heart-shaped; little lobed, but coarsely and sharply toothed; clusters loose; fruit small bluish or black with a bloom; very sour; ripe after frost. Var. *riparia*, the common form along river-banks west, has broader and more cut or lobed leaves. (Gray.)

Varieties.

Aughwick. (?)
Cowan.
Clinton.
Case.
Franklin.
Golden Clinton.
Gravel.
Huntingdon.
Kitchen.
Oporto.
Osmond.
Regina.
Shearman.
Taylor's Bullitt.
Winslow. (?)

SECTION 4. *Vitis vulpina, Bullace grape.*—River-banks from Maryland and Kentucky, south; leaves rather small; round in outline; seldom but sometimes slightly lobed; glossy and mostly smooth on both sides, the margin cut into coarse and broad teeth; clusters small; fruit large, purple, thick-skinned, musky, or pleasant flavored; ripe in early autumn. (Gray.)

Varieties.

Flowers. Mish. Scuppernong. Thomas.

SECTION 5. *Vitis vinifera, European grape.*—The following varieties of this species are sometimes classed as native grapes:

Brandywine.
Brinckle.
Canadian Chief.
Child's Superb.
Clara.
Carpenter.
Emily.
El Paso.
Fedora.
Gutedel.
Jacobi.
Katarka.
Louisiana.
Montgomery.
Old Mission.
Rulander.
Sweetwater.
Weehawken.
Yeddo.

SECTION 6. *Reputed hybrids and crosses.*—1. Hybrids between *V. vinifera* and *V. labrusca;* Allen's hybrid, Agawam, Barry, Clover street Black; Clover street Red; Croton, Challenge, Conqueror, Diana Hamburg, Essex, Gærtner, Goethe, Herbert, Lindley, Merrimack, Massasoit, Requa, Rogers' Hybrids, Salem, Wilder. 2. Hybrids between *V. vinifera* and *V. cordifolia:* Autuchon, Brant, Canada, Cornucopia, Othello. 3. Hybrids between *V. æstivalis* and *V. labrusca:* Delaware, Raabe. 4. Crosses between *Diana* and *Delaware:* Onondaga, Walter.

REMARKS.

SECTION 1. *Vitis labrusca.*—This species furnishes by far the largest number of varieties. The superior size attained both in bunch and berry, the hardiness and productiveness of the plants, and the fair qualities of the fruit, in many of the varieties, have, no doubt, encouraged the production of seedlings from this section. It must be allowed, however, that, notwithstanding the great number of varieties which have been introduced during the past fifty years, there has been but slight improvement made in the quality of the fruit. The Catawba was brought into cultivation about half a century ago, and the high estimation in which it is still held is proved by the fact that the highest recommendation which a new variety can receive in a published list is that "it is as good as a well-ripened Catawba," and this can be truthfully said of only a very few of even the most popular varieties.

The fact that the Catawba suffers so frequently from fungoid and other diseases, and the lengthened season that is required for the perfection of its fruit, have caused it to be in a great degree superseded by kinds of inferior quality, but of a hardier and healthier stock, and earlier maturity.

For table use, this species, in its improved varieties, will probably always occupy a prominent position in a large portion of the eastern and the northern States as well as in the northern sections of the western states; and in those regions where the climate will not favor the maturity of the best varieties of this class the inferior kinds will occupy their place.

As a wine grape the *V. labrusca* has been overestimated; the tough, musky pulp of even the best varieties requires a long and favorable season of growth to soften and reduce the acid center so as to produce a proper ratio of the ingredients necessary for a passable quality of wine. From the earlier ripening varieties wine may be made; but the general inferior quality of their fruits seems to preclude the possibility of securing wines of merit from this source.

It is to be regretted that the best fruited varieties of this species are so subject to disease, both in foliage and fruit, as to prohibit their profitable culture in many districts. Excellence of fruit is no criterion as to the value of any variety for general planting, as the most popular kinds are only second-rate as to flavor. It appears that the finest flavored fruits are the products of the more delicate plants, which are more sensitive to casualties from unfavorable conditions of soil and atmospheric changes of climate. New varieties should, therefore, be introduced cautiously into all localities except those specially distinguished as grape-growing regions. So far as they have been sufficiently tested, the Catawba, Iona, Diana, Maxatawny, Creveling, Israella, Rebecca, and Adirondack are the best and most delicately-flavored varieties of this section, when fully ripened. It may not be out of place here to remark that no grape attains full maturity until the wood or shoot supporting the bunch becomes brown and hard, and the foliage is assuming its autumn colorings; in other words, ripe fruit cannot be gathered from unripe wood, the ripening of the fruit depending upon the general maturity of the current growth of the plant. I am aware that this but seldom occurs in ordinary culture and management, the fruit being gathered, usually, long previous to the ripening of the wood; that is to say, the fruit is picked before maturity.

Among those of secondary flavor, but of a healthy nature and robust growth, and therefore suitable for general culture, are the Concord, Ives, Perkins, Hartford Prolific, and Rachel.

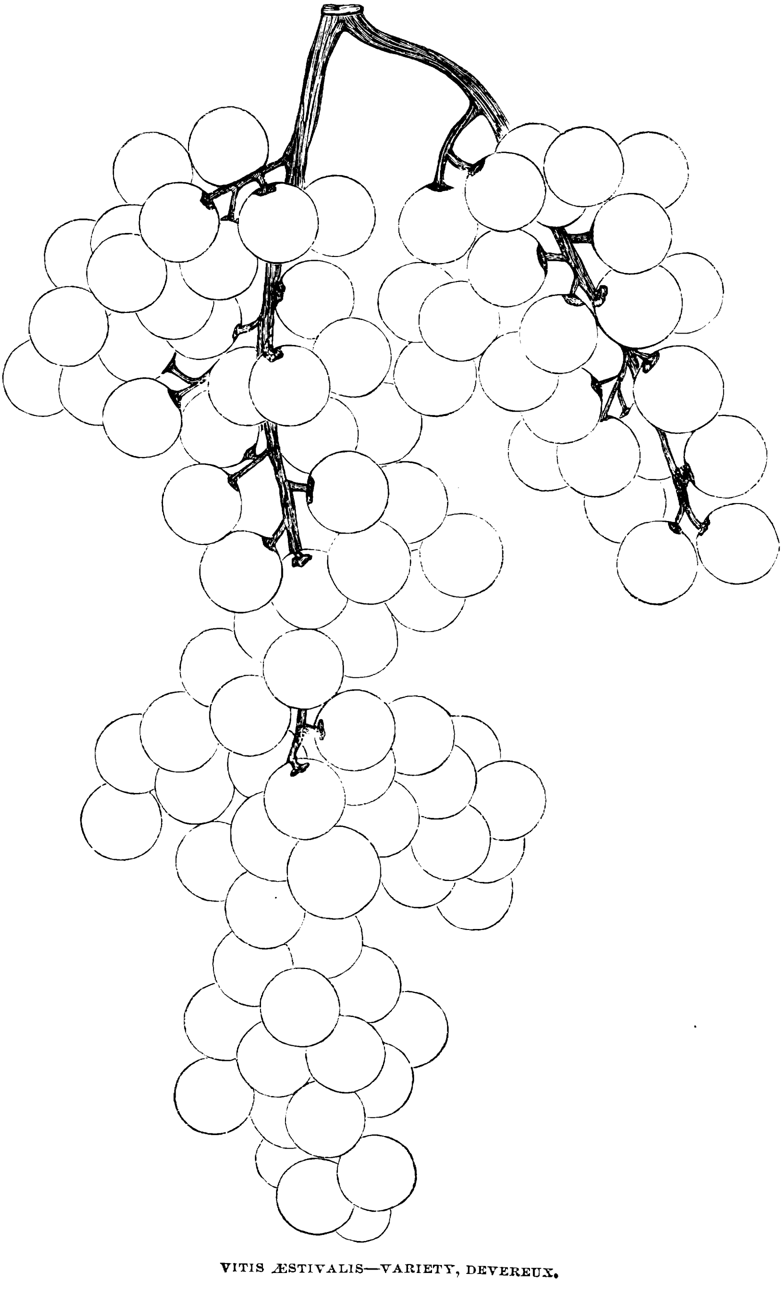
Some of the more recent introductions will, undoubtedly, be placed in these lists when they have been fairly tested. The most promising of these are the Martha, Mottled, Cottage, Modena, Paxton, Christine, and Una.

SECTION 2. *Vitis æstivalis.*—This species is pre-eminently the wine grape of the Atlantic States. Owing to the fact that none of the varieties except the Elsingburgh will ripen north of the parallel of 40°, unless it may be in some peculiarly favored situation, they have not been extensively planted, and their superior qualities are but little known. The berries are destitute of pulp, and the juice contains a larger percentage of sugar than any other improved American species. The foliage is not so liable to disease as that of the fox grape, and rot in the berries is comparatively unknown. Some of the best wines made in this country are produced from varieties of this family, although the most promising kinds have not been properly tested as to their wine-producing qualities. I am convinced that neither the wine-producing capabilities of the country nor the highest excellence of the product can be decided until vineyards of these varieties are established in the best locations of favorable climates.

The distinction, so well understood and acted upon in Europe, between grapes for table use and those for wine, must also be recognized here sooner or later if the wine interest is to be brought up to any great degree of excellence, and maintained as a source of national industry and wealth.

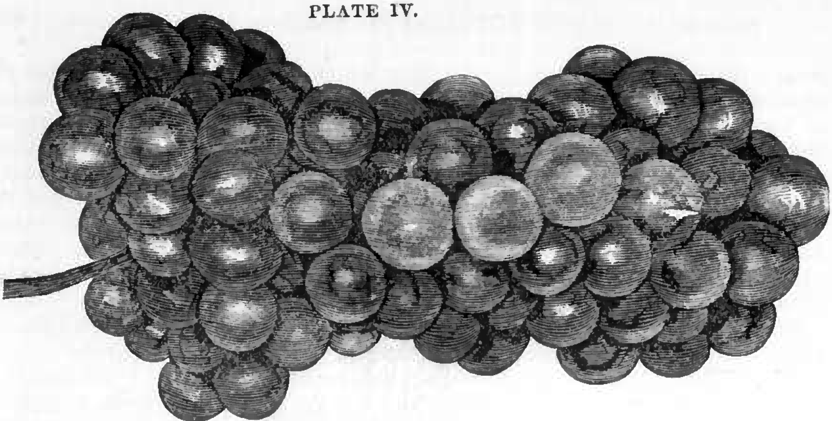
The mountain slopes and plateaus in Virginia, North Carolina, Tenn-

PLATE III.



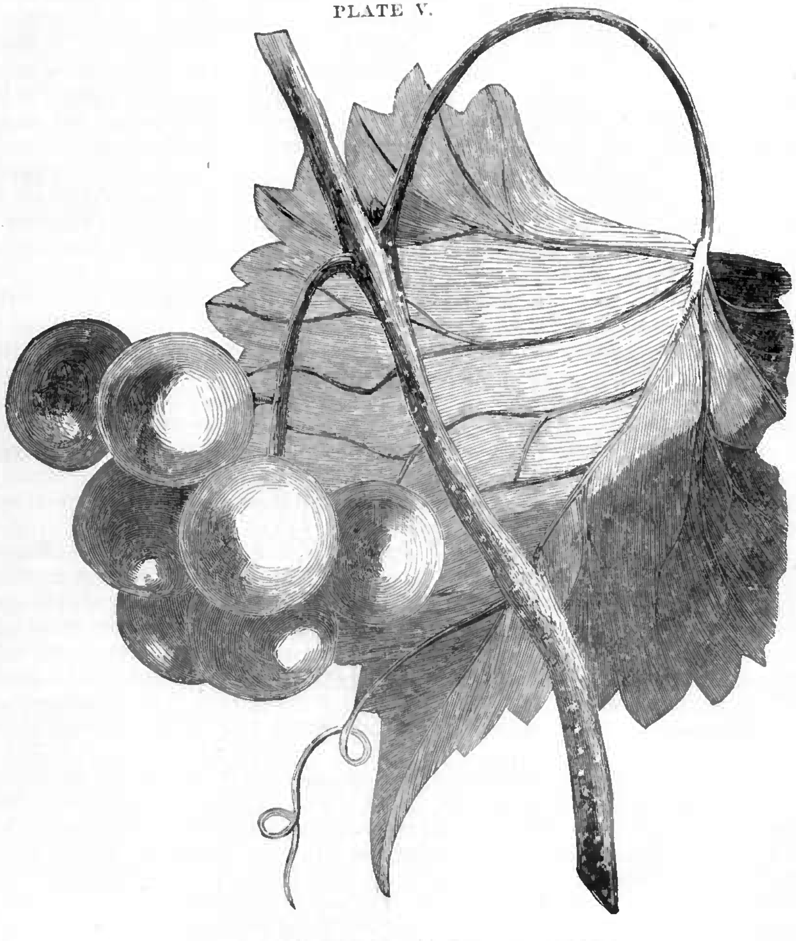
VITIS ÆSTIVALIS—VARIETY, DEVEREUX.

PLATE IV.



VITIS CORDIFOLIA—VARIETY, CLINTON.

PLATE V.



VITIS VULPINA—VARIETY, SCUPPERNONG.

essee, Arkansas, Missouri, and other southern States must be looked upon as the great producing regions of this continent for a certain class of fine wines, not excepting California and other favored sections of the Pacific coast. It is well understood that warm, dry countries produce high wines of much spirit, but greatly deficient in the delicate aroma, exquisite bouquet, and healthful tonic properties possessed by wines produced in climates having a long season of comparatively equable temperature, which have in all ages been renowned for their superexcellent qualities. We must depend upon this section for the "coming wine grape."

The most promising varieties on the present list are Baldwin's Lenoir, Herbemont, Alvey, Cynthiana, Devereux, and Norton's Virginia.

SECTION 3. *Vitis cordifolia.*—This section represents the most healthy grapes of the northern States. The foliage is rarely attacked by mildew, although the leaves, possibly owing to their smoothness, are occasionally injured by insect punctures. The fruit is not subject to rot, and is noted for keeping well after being gathered from the plant. It is late in maturing, and seems to reach its highest condition by remaining on the vine until the thermometer indicates proximity to the freezing point, when, even in northern localities, it proves to be a fruit of fair quality either for table or wine. Of course its quality is greatly improved by the length and geniality of the season of growth; for example, those who are familiar with the fruit only as a production of Massachusetts would not recognize its flavor and vinous character as ripened in southern Maryland or Virginia. The greatest objection to it as a wine grape is that of having too much acid. The fruit is not so deficient in sugar as is generally supposed, having enough of this important ingredient for a good wine.

The grapes of this section have been condemned, it may be with undue haste, as wine grapes, on account of their great acidity. Analysis shows that they have a sufficiency of sugar, and it seems probable that the wines only require age to develop their qualities.

It is known that wines from the Clinton variety, when kept in a suitable cellar from four to six years, assume a very fine character. There is abundant evidence to favor the belief, that if as much time and care had been devoted to the improvement of this species as has been given to the Fox family, we should now be in possession of a good northern red-wine grape.

The mode of management and culture has also a decided influence upon the productiveness of this species. The shoots grow with much vigor during early summer, frequently forming canes fourteen to twenty feet in length before the end of the season, on young plants in good soil. On these canes the best developed buds are some distance from the base, or point of growth on the stem; consequently, if cut closely back at the fall or winter pruning, the best buds for fruit bearing are removed, and a luxuriant growth of wood, with a minimum crop of fruit, will be the result.

Heavy crops are produced by suspending shoots of eight to twelve feet in length in a horizontal position, removing them completely after the crop is gathered, and in turn replacing them with young growth.

The most promising varieties are the Clinton, Franklin, Huntingdon, Taylor, and Oporto.

SECTION 4. *Vitis vulpina.*—This species may be termed the tropical grape. It is strictly confined to the southern States, not growing north of Virginia, and in foliage and wood is very unlike any other grape, either native or foreign. It is peculiarly adapted to a low, warm country,

flourishing well in rich alluvial soils, and on the low banks of streams. It is entirely exempt from mildew, rot or any of the diseases so disastrous to the northern species. As a wine grape its unequaled *bouquet* is the principal recommendation. It is deficient in sugar, and the juice is usually *gallized*, fortified by the addition of alcohol, or otherwise manipulated. Samples of wine made from carefully-selected and thoroughly ripened fruit have been pronounced unexceptionable by good judges.

No great attention has been given to the culture of this species. The vines produce so abundantly without any particular care that none has been thought necessary. It is quite likely that, either by improved culture of the present varieties, or by carefully selecting improved seedlings, a greatly superior fruit may be produced, and a famous wine grape secured.

The Scuppernong has long been highly prized both as a wine and table fruit. The Mish and the Flowers are also esteemed, the last named being of later maturity than the others.

SECTION 5. *Vitis vinifera*.—In sheltered places, more particularly in cities, many varieties of the foreign grape flourish for a time, and this isolated and partial success maintains a lingering hope in the minds of some persons that the difficulties pertaining to the general field culture of this species in the Atlantic States may ultimately be overcome. There seems to be no fundamental encouragement for any such hopes, however.

So many experiments have been made with numerous varieties previous to and during the present century, all ending with the same disappointing results, that we are forced to the settled conviction, that they are not adapted to the climates of this country east of the Rocky Mountains.

On the western coast, in the Pacific States, they form the staple crop of the vineyards, and succeed equally as well as in the best locations in Europe, and far better than in some of them. The only cause of failure is that of fungoid growths, or mildew, on the young fruit and foliage. Both the length and warmth of our summers are sufficient to ripen them over a large extent of territory. In the Old World they are cultivated from the twenty-first to the fifty-second degree of latitude.

The idea is somewhat prevalent that the want of success is owing to the severity of our winters; this is not strictly, although apparently, the reason. Probably there are none of the foreign varieties that would not resist our most severe winters south of the forty-second degree of latitude, provided their growths had reached maturity; but when the growth is checked during summer, either by mildew on the leaves, or from any other cause, the wood fails to become hard or ripe, and in this state is unable to withstand the action of frost. The injury from this disease is often insidiously gradual. The destruction of foliage during the most vital period of growth prevents the hardening of the wood, which is then partially destroyed by the winter colds. A feeble spring growth ensues, more liable to fungoid attacks, and a continuation of such calamities speedily enfeebles the vitality of the plant, and it eventually succumbs. It has further been supposed that seedlings from the foreign species, raised in our fields, and fully exposed to the climate from the earliest stages of growth, would prove more hardy. This is, of course, a fallacious supposition, but it has given existence and temporary repute to most of the varieties named in this section.

SECTION 6. *Reputed hybrids*.—With a view to increasing the value of the native grapes various efforts have been made to secure a hybrid between them and *Vitis vinifera*. The practicability of the successful

hybridizing of these species has been questioned, but recent experiments seem to confirm the expectations of those who favored the practice, although doubters still exist.

There is certainly more reason to doubt the probability of securing a good hardy grape by this course than there is in doubting the practicability of the operation. One of the chief difficulties met with in the culture of our native varieties is their tendency to leaf mildew and fruit rot. As has been stated, healthy kinds are the most popular, regardless of the inferior quality of their fruit. The foreign grape is altogether unsuited for regions where the native varieties are most valuable. The atmospheric influences that partially injure the native completely destroy the foreign grape; so that, hypothetically considered, the production of a healthy form in a hybrid between two unhealthy ones is highly improbable. The results of hybridization with these species go far to prove the soundness of this hypothesis. The adaptability of the hybrids to climate is in proportion to their affinity to the native parent.

The great object of the hybridizer is to increase the sugar element in the native grape. As compared with the best wine grapes of Europe, the improved American varieties do not materially lack in this element. An excess of acid, rather than a deficiency of sugar, is found to occur. This may be an important point of distinction in the chemical aspect of amelioration; for it cannot be questioned that any improvement so far attained in hardy grapes is the result of selection, rather than from any known intermixture of species.

The hybrids of *V. labrusca* and *V. vinifera* do not prove of superior excellence, and have not yet produced a fruit equal to the best of the native varieties, on an equally hardy plant. The hybrids between *V. vinifera* and *V. cordifolia* are of too recent introduction to be thoroughly tested. The *V. cordifolia* being the most healthy of our natives, may exert an influence on the health of the young stock.

It has been proposed, in order to test the purity of hybrids, to raise seedlings from them, on the supposition that the young plants would vary in their resemblance to the one or the other of the parents, and exhibit more distinctly the characteristics of the form assumed. I am not aware of any extensive experiments in this line that might warrant an opinion conclusive as to the verity of hybridity. Among several hundred plants raised here from one section of these hybrids, the forms are invariably those characteristic of the native species. Nothing approaching to the foreign parent has been observed.

If the foreign species proved in all respects well adapted to this climate, there could be no objection to its use in this particular operation; but as it must carry with it a diseased and inherently faulty constitution, there seems to be no encouragement for further attempts, neither does it seem at all necessary. A series of hybrids from properly directed and carefully conducted manipulations between native species offers far greater expectations of valuable results.

The distinctions of species, varieties, and the climates and purposes to which they are severally adapted, must ultimately be recognized as the basis upon which wine culture is to be established and upheld in this country, more particularly so far as it refers to native grapes.

GRASSES AND FORAGE PLANTS.

The accompanying table shows the relative growths from seeds sown April 5th and May 5th. The weather up to May proved quite genial and favorable. Heavy rains, followed by cold drying winds, prevailed

during the first half of this month, and retarded growth to a great extent. Toward the end of May and throughout the month of June the weather was warm, with occasional showers of rain. July was for the most part dry—severely so toward the end of the month. No noteworthy growth was observed after the 1st of August. Soil, a fertile clay loam, rather damp than otherwise.

Table showing relative growth of certain grasses.

	April 27.	May 4.	May 15.	May 23.	June 7.	June 18.	July 2.	July 16.	July 27.		Condition Dec. 10.
SOWN APRIL 5, 1869.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*		
Agrostis vulgaris	....	½	¾	1	3	4½	6	7	8	....	Browned.
alba	....	½	¾	1	2½	4	7	10	10	....	Do.
canina	....	½	¾	2	3	3	5	6	6	....	Green.
stolonifera	....	½	¾	1	2	3½	5	6	6	....	Brown.
Avena flavescens	....	½	½	1	2	2	3	4	5	....	Green.
Anthoxanthum odoratum	....	1	1	1½	2½	3½	3½	4	5	....	Brown.
Arrhenatherum avenaceum	....	½	1½	5	10	20	28	32	....	Bloom.	Do.
Alopecurus pratensis	....	½	½	½	2½	4	5	6	6	....	Do.
geniculatus	....	½	½	2½	4½	6	12	14	....	Bloom.	Green.
Ammophila arundinacea	....	....	....	½	1	1½	4	5	6	....	Brown.
Aira flexuosa	....	....	½	1	1½	2	2½	3	4	....	Green.
cæspitosa	....	....	½	1½	4	7	7	8	9	....	Do.
Bromus unioloides	½	2	3	5½	9	16	22	....	....	Bloom.	Do.
secalinus	....	....	½	2	5	9	10	14	18	....	Do.
pratensis	½	1½	2	7	18	27	40	....	....	Bloom.	Do.
mollis	....	....	½	3	5	8	10	12	13	....	Do.
pinnatus	....	....	½	1	3	4½	7	10	12	....	Do.
Cynosurus cristatus	½	1	1½	3½	7	12	13	15	16	....	Brown.
Dactylis glomerata	½	2	3	4½	7	10	14	15	17	....	Do.
Eleusine coracana	....	½	¾	1	3	6	17	24	28	Bloom.	Dead.
tocussa	....	½	½	1	5	10	23	36	42	..do...	Do.
Festuca loliacea	....	1	2	3½	6	12	18	22	22	....	Green.
heterophylla	....	½	1	2	4	6	8	14	14	....	Brown.
elatior	½	3	3½	5	7	12	14	17	18	....	Do.
duriuscula	....	½	1	1½	2½	4	5	6	6	....	Do.
ovina	....	½	½	1	1½	2	3	3	3	....	Very green
fluitans	....	....	½	2	4	6	6	7	7	....	Green.
rubra	....	½	1	2	3	4	6	7	8	....	Do.
pratensis	1	2	4	7	11	17	20	22	22	....	Do.
tenuifolia	....	½	½	1	2	3½	5	5	5	....	Do.
Glyceria fluitans	....	½	1	2	3½	5	7	9	10	....	Do.
Holcus lanatus	....	½	1	3	5	10	14	17	17	....	Do.
mollis	....	½	1	2	5	7	8	9	9	....	Do.
Hordeum bulbosum	....	½	2	3	4½	7	9	10	12	....	Do.
Lolium Italicum	2	2½	3	6	9	14	15	16	16	....	Do.
perenne	2	3	4	7	12	15	16	18	18	....	Do.
Poa trivialis	....	⅓	1	2½	4	8	18	....	....	Bloom.	Do.
pratensis	....	½	1	2	4	6	10	12	12	....	Do.
nemoralis	....	½	1	2	4	12	17	18	....	Bloom.	Do.
annua	½	½	1	1½	3	6	....	....	....	..do...	Dead.
aquatica	....	....	½	1	2	2	2	3	3	....	Green.
Paspalum stoloniferum	....	½	1	2½	5	13	26	34	....	Bloom.	Dead.
Panicum sanguinale	....	½	½	2	5	13	34	35	....	..do...	Do.
Phalaris arundinacea	....	1	1½	4	12	16	22	26	26	....	Brown.
SOWN MAY 5, 1869.											
Trifolium hybridum	....	....	....	½	1	3	4	5	5	....	Green.
pratense	....	....	....	½	2	4	5	6	7	....	Do.
repens	....	....	....	½	¾	2	2½	2½	2½	....	Do.
Medicago sativa	....	....	....	....	1	4	4	6	7	....	Do.
Anthyllis vulneraria	....	....	....	½	2	3	3	4	4	....	Do.
Galega officinalis	....	....	....	....	1	3	4	7	8	....	Do.
Lespedeza striata	....	....	....		....	½	1	2	3	....	Dead.

REMARKS.

Agrostis vulgaris (red-top grass) and *Agrostis alba* (white-top grass or white bent) are well known valuable meadow grasses. Red-top is in much repute as a lawn grass, but is apt to become thin and wiry in dry weather, unless on deep rich soils; it also presents a brown appearance in cold weather. The white bent is the English grass of some eastern

States, valuable only for its growth in wet lands where the finer grasses will not survive.

Avena flavescens (yellow oat grass) forms a close sward, and stands well in a dry season or on thin soils, and is much sought by sheep.

Anthoxanthum odoratum (sweet-scented vernal grass) yields only a moderate amount of herbage, grows up early in spring, and imparts to meadow hay fields a peculiar and pleasant fragrance when in flower or when cut down.

Arrhenatherum avenaceum (French rye or ray grass) grows rapidly, forming a bulky, coarse herbage, and shoots up freely after being cut down.

Alopecurus pratensis (meadow fox-tail grass) is considered a valuable pasture grass, as it has broad root leaves and grows quickly when eaten down. Its dwarf-spreading habit of growth renders it of little value for hay. It is good for permanent pastures.

Aira flexuosa (wood hair grass) and *Aira cæspitosa* (hassock grass) are of no agricultural value. The last named will form a green herbage in wet places.

Bromus unioloides (Schrader's brome grass.) This Australian plant has lately been brought into prominent notice on the continent of Europe and in Great Britain, as likely to supersede the Italian rye grass for soiling cattle and for irrigated meadows. Although it produces a great amount of foliage, it is neither so early nor so fine as the rye grass. The seeds are nearly as large as oats and yield heavily, but the ripening of the seeds entirely stops the growth until the stems are cut. Frequent mowing or constant grazing is necessary to reap the best results from this species. When young all kinds of stock eat it freely.

Bromus secalinus is the well known chess or cheat of grain fields.

Bromus pratensis (meadow brome grass) is a fast-growing plant, and apparently stands dry weather better than most kinds of grass.

Cynosurus cristatus (crested dog's tail grass) enters largely into the imported mixtures of so-called lawn grasses. Its close-growing, spreading habit renders it very suitable for this purpose. It has been found to adapt itself to various conditions of soil, doing well on wet lands, and standing up well in dry weather on dry soils. In this climate it becomes very brown in winter.

Dactylis glomerata (orchard grass) is deservedly a highly esteemed grass both for pasture and hay, which, although somewhat coarse, is very nutritious. Its rapid growth makes it valuable for grazing, coming up early in spring and retaining growth well in dry weather. On rich soils it is apt to become tufty, therefore not well adapted to fine lawns.

Eleusine coracana and *Eleusine tocussa* are annual grasses of coarse herbage, producing abundant crops of seed resembling millet, and are said to enter largely into the food of the poorer classes of some parts of India. On the Coromandel coast it is known as the Natchanee grain, and is the Raggee of the Mohammedans. The common crab-grass of our waysides, and the pest of our lawns, is *Eleusine indica*.

Festuca loliacea, (darnel-leaved fescue grass,) as its name implies, is similar in appearance to the rye grass, and is well adapted to marshy lands or those occasionally overflowed.

Festuca pratensis (meadow fescue grass) is a valuable pasture grass on rich moist lands. The leaves are tender and succulent, although coarse in appearance, and it never forms rank tufts like many of the heavy foliaged grasses. All kinds of live stock are partial to it.

Festuca duriuscula, (hard fescue grass,) *Festuca ovina*, (sheep fescue

grass,) and *Festuca rubra*, (red fescue grass,) are dwarf-growing species well adapted to dry soils, and famed for sheep pastures. Mutton fed on the *F. ovina* has a traditionary reputation for excellence.

Holcus lanatus and *Holcus mollis* are soft woolly grasses of no agricultural value. They grow only in damp, shady woods or bogs, and are not relished by cattle.

Lolium Italicum (Italian rye grass) is a biennial grass of rapid growth and of good qualities, producing enormous crops when it receives plenty of heat and moisture. For irrigated meadows it is considered unequaled. Reports from England state that when irrigated with town sewage, eighty tons of green food have been cut from one acre in a single season. In mild winters here it has retained a tall herbage through the winter. A rich moist soil is essential to produce it in the greatest perfection. If sown in August or September here and in the South, it would form a good cutting crop in the following year before the hot summer commences.

Lolium perenne (perennial rye grass) is the principal haying grass of Great Britain, to which climate it is well adapted. On dry soils and during dry weather it grows feebly in this climate, but is a valuable pasture grass in moist soils and drained clay lands.

Poa pratensis (June grass, Kentucky blue grass) is undoubtedly our best lawn grass, and also one of the best for permanent pastures. It forms a close thick-set sward under the lawn mowing machine, standing the summer droughts as well as any other, and maintaining a remarkably fresh, green color during winter. When not cut or grazed, on good bottom lands it becomes somewhat tufty, but is never coarse. It commences growth very early in spring.

Poa trivialis (rough stalked meadow grass) is a valuable pasture grass, especially on damp meadows. It grows up early in the spring, but readily succumbs to dry weather on dry upland soils.

Poa nemoralis (wood meadow grass) is a free growing grass, specially adapted to shady places, such as under trees on a lawn. A good sort for moist lands.

Glyceria fluitans (floating meadow grass) thrives well in water, and is consequently well suited for very wet lands frequently inundated, and for banks of wet ditches, pools, and similar situations. Ducks and other water fowls seek out the large seeds of this species and feed upon them.

Phalaris arundinacea (reed canary grass) grows well on rich alluvial lands. The well-known ribbon grass of gardens is a striped variety of this species. It forms coarse herbage, not much sought by cattle.

Trifolium hybridum (Alsike clover) in general appearance and habit of growth is intermediate between the common red and the white clover. It is highly valuable for pasturage, growing rapidly after being eaten down, and furnishing a large amount of food during the season. The stems remain soft and succulent even when old, never becoming so woody and hard as the red clover; it also partakes of the creeping, spreading habit of the white clover. It yields well when cut for hay, being thick and close, although not so tall in growth as the red clover.

Trifolium pratense (red clover) and *Trifolium repens* (white clover) are both well-known forage plants.

Medicago sativa (lucerne, alfalfa) is a well-known leguminous plant, cultivated for its forage. It succeeds well on deep, loose, sandy soils, rooting deeply and consequently standing well in dry seasons. It is valuable for soiling cattle, and increases in vigor for several years after sowing.

Galega officinalis (goat's rue) is sometimes grown as a forage plant, but is of no special value.

Anthyllis vulneraria (kidney vetch, sand clover) is of no value as herbage, although it has been recommended for this purpose.

Lespedeza striata (Japan bush clover) is a leguminous plant that has lately attracted some attention in the southern States as a forage plant. It is poorly adapted to any such use, and not by any means worthy of recognition by the cultivator. It is a low, hard-wooded annual, spreading freely on sandy and poor soils, with very small and scanty foliage.

ARBORETUM.

A commencement in planting the arboretum was made early in the spring, and the work was prosecuted as far as means allowed. The plan of combining a strictly botanical arrangement with landscape gardening effect has been closely followed, but several years must elapse before the merely ornamental effect will be fully developed.

The construction of the walks and roads has been suspended, as also the completion of the planting, until funds are appropriated for these purposes.

In connection with this work, the collection of plants useful in the arts is prominent. These are, for the present, classed in sections as follows: dye, gum, sugar, fiber, oil, and medicinal plants. A more detailed classification will be adopted as the collections advance in numbers.

WILLIAM SAUNDERS,
Superintendent.

HON. HORACE CAPRON, *Commissioner.*

REPORT OF THE BOTANIST.

SIR: In entering upon the duties of botanist to the Department of Agriculture in March, 1869, my first care was directed to the arrangement of the large and valuable collection of dried plants received from the Smithsonian Institution.

This herbarium, comprising all the collections that had accumulated from the different government surveys, as well as contributions from a great variety of sources, both at home and abroad, had previously passed through the hands of the eminent American botanists, Professors Torrey and Gray, by whom they had been labeled and referred to their proper genera and species, which very materially diminished the labor of subsequent rearrangement. The gratuitous labor bestowed on this collection by Professor Torrey, not simply in naming, but in preparing the plants for permanent preservation, can be properly appreciated only by those who have had experience in this kind of labor; and his continued and unwearied interest in the same will justly entitle him to the gratitude of all who may hereafter succeed to the guardianship of this national herbarium.

GENERAL CHARACTER OF THE COLLECTION.

Owing to the peculiar circumstances under which this collection has been made, it being the accumulated results of the various government surveys, as well as irregular contributions from a great variety of miscellaneous sources, it lacks completeness, and is deficient in many of the

more common plants of accessible districts, though exceedingly rich in rare specimens, and representing localities and regions difficult of access. These deficiencies, however, can be readily supplied as they are developed in carrying out the systematic arrangement adopted, and the accumulated duplicates will afford the means of procuring *desiderata* through exchanges.

The general collection is now estimated to contain fifteen thousand species of plants, and not less than twenty thousand specimens. At the ordinary rate of increase, additions may be expected of from two thousand to three thousand species annually, with a still larger number of duplicates; and, by judicious management, the collection will eventually attain its proper rank as a national herbarium.

ADDITIONS DURING THE YEAR.

During the past season the principal additions to the botanical collections have been derived from the following sources, viz:

From the Smithsonian Institution, a large number of wood sections, mostly South American and Mexican, with vernacular names; similar specimens from the west coast of North America and the Pacific islands, derived mainly from Wilkes's exploring expedition; and numerous smaller collections from Europe and North America, partly named or numbered, referring to published lists accompanying the specimens; also *fasciculi* of systematic collections of dried lichens, fungi, and mosses, together with numerous specimens of fruits, fibers, and economical vegetable products.

From H. W. Ravenel, of Aiken, South Carolina, a complete set of the fungi collected by him in Texas, in the spring of 1869, while engaged with the special commission from the Department of Agriculture in the examination of the Texas cattle disease. The collection includes native grasses and other flowering plants, amounting in all to about six hundred species. The Department has also purchased from Mr. Ravenel five volumes of systematic collections of southern fungi, properly named and mounted, together with a set of four hundred and twenty species of South Carolina plants mainly from the vicinity of Aiken, South Carolina.

From William M. Canby, of Wilmington, Delaware, by donation, a choice collection of dried plants, comprising two hundred and twenty-five species, gathered by this gentleman in Florida, Georgia, and North Carolina, in the spring of 1869.

From Professor John Torrey, of New York, a large number of valuable duplicates, selected from the Torrey herbarium, of Columbia College, prepared and put in form to be directly incorporated into the general collection.

From Dr. Arthur Schott, of Georgetown, D. C., a full collection of Yucatan plants, collected by him during his connection with the scientific survey of that region, under Governor Salazar, during the years 1864, 1865, and 1866.

From Dr. F. V. Hayden, the botanical collections made by Cyrus Thomas, in connection with the geological survey of Colorado and New Mexico, in 1869, including about three hundred and seventy-five species and numerous duplicates.

From Elihu Hall, of Menard County, Illinois, several parcels of western plants, including some of the rarer grasses of the western plains and Rocky Mountain slopes.

From Dr. George Vasey, of Richview, Illinois, a small set of the plants collected by him, in 1868, on the Colorado exploring expedition, conducted by Major J. W. Powell.

From Dr. E. Foreman and H. Brummel, sets of plants collected in the vicinity of Washington, D. C., in 1869.

From Professor H. N. Bolander and R. E. C. Stearns, of San Francisco, California, a large and valuable assortment of pine cones from the mountain districts of California.

THE COLLECTIONS OF DR. EDWARD PALMER.

The largest and most important addition to the botanical collection has been derived from the explorations of Dr. Edward Palmer, who was employed by the Agricultural Department, in connection with the Smithsonian Institution and Army Medical Museum, to make a collecting tour through western New Mexico and central Arizona. Dr. Palmer left Washington, March 14, 1869, and arrived at Fort Wingate, New Mexico, May 5, at which point he commenced his collections. Passing westward through the Moqui Pueblo towns, and thence along the southern slopes of the San Francisco Mountains, he reached the highest point of the latter in July. After securing the summer plants of this high mountain district, he proceeded, by way of Prescott, through the desert districts of western Arizona, and along the course of the Colorado River to its mouth; returning late in the season through southern Arizona, by the Gila River, to Tucson; thence by way of Altar and Hermosilla to Guaymas, in Sonora; and from the latter place proceeded by sea to San Francisco, reaching that city in January, 1870.

The results of Dr. Palmer's labors, a part only of which have yet come to hand, include many living plants and seeds which are now growing in the propagating houses of the Department.

The dried plants thus far received number about four hundred species, of which twelve or more are new to science, and will be described by Professors Gray and Torrey.

The numerous duplicates received have been distributed to prominent botanists in this country and in Europe, and will secure valuable returns to the Department in the way of scientific exchanges. The policy of continuing such collections under the direction of the Agricultural Department is manifest, and it is desirable that specific appropriations for this object should be regularly made.

EXPLORATIONS BY THE BOTANIST.

A favorable opportunity offering for making a personal examination of the region adjoining the western extension of the Kansas Pacific railway, reaching to the base of the Rocky Mountains and the Upper Arkansas Valley, I spent nearly two months in that region, occupying the greater part of September and October, 1869. An instructive exhibition of the influence of climate in modifying agricultural production is brought to view in passing from the luxuriant fields of eastern and central Kansas to the more elevated and arid plains to the westward. Though the soil continues to exhibit all the evidences of agricultural capacity, in a deep rich loam, charged with all the mineral elements of fertility, the absence of sufficient moisture in the atmosphere restricts the growth to varieties of low tufted grasses and peculiar plants adapted to arid climates. Along the course of the wide, open valleys and intermittent water-courses, variable groves of cottonwood and willow are met with, which constitute the only native sources of timber growth for this section remote from the pine region directly adjoining the base of the Rocky Mountains. These characteristics are so plainly

marked in the vegetation as to offer at once a satisfactory answer to the question as to the natural capacities of this district for cultivation or settlement. Variable seasons may allow the occasional successful production of quick maturing grains on the grassy uplands, and favorable locations, supplied with constant water from running streams or fed from artesian wells, may yield regular crops on limited areas; yet it remains a question to be solved by actual experiment whether better varieties can be introduced to take the place of the nutritious buffalo and grama grasses for grazing purposes, or whether on the lowlands any introduced timber growth can better withstand the vicissitudes of climate than the persistent western cottonwood. The native western grasses are by this time well known, both as regards their botanical characters and their nutritious grazing properties; and, with the disappearance of the untamed buffalo, their economical meat-producing qualities for domestic herds will soon be fully established.

The practical question of tree growth assumes a much greater importance in approaching the base of the Rocky Mountains, where elevation comes in to supply different conditions more favorable to arborescent vegetation. Thus the intense evaporation that robs the plains below of the greater portion of their superficial moisture, drying up or diminishing the numerous water-courses and wide, shallow river beds, charges the upper atmosphere with moisture, which is again deposited in the form of dew or rain on surfaces sufficiently elevated to become condensers. This capacity for condensation is met at an elevation of nearly seven thousand feet above the sea level, and at this point trees for the first time make their appearance on the uplands. An elevated scope of country not directly or geologically connected with the Rocky Mountain range is met with to the south and southeast of Denver, comprising a high and irregular divide between the waters of the Platte and the Arkansas River after their exit from the mountains. Here thrifty pine forests give a picturesque character to the moderately rugged landscape, while the accompanying undergrowth also indicates a moister soil, which has been found suited to ordinary field culture without the necessity of resorting to artificial irrigation.

The practical questions connected with this more favorable condition of agricultural production regard, first, the extension of this tree growth by protecting the growing timber from injury by roving cattle, and, still more, the wholesale destruction of the large forests by the woodman's ax and that which follows closely in its train, the sweeping ravages of fire.

The protection of our native forests now constitutes one of the urgent problems in reference to the future of the mountain districts of the far West. The advent of railroads, the progress of mining operations, as well as the general advance of settlement, call for large amounts of fuel, which will be taken from the most available sources without regard to the future; hence there is great danger that the entire country will be stripped of its protecting belts of timber, leaving the exposed soil a prey to those floods and droughts which in European countries have invariably followed the entire destruction of forests.

Therefore, not only proper means of protection should be devised and enforced by government authority, but encouragement also should be given to extend the growth of forests, by the introduction of new varieties adapted to the peculiar conditions of soil and climate.

To one acquainted with our eastern forests, the scarcity or entire absence of many of the ordinary forms of deciduous tree growth in the Rocky Mountain timber districts is noticeable. Thus, we nowhere meet

with the familiar species elsewhere exhibited in the elm, walnut, beech, &c., while other still larger genera, including the oak, maple, and birch, are represented only by single dwarf species. The pines and firs, including eight different species, comprise the entire mass of the mountain forests, interspersed here and there by patches of aspen poplar. In this condition of things it is impossible to resist the conclusion that either the climate or soil, or both, are unfavorable to the growth of deciduous-leafed trees; and, hence, that the ordinary condition of forest rotation, in which evergreens alternate with the deciduous tree growth, can not be expected. It is this latter fact which gives special force to the argument which insists on the protection of the native forests and their extension over suitable districts. It is to be hoped that judicious experiment and observation on these points may be soon put in operation to determine the best course for the promotion of this important branch of tree culture in the far West.

The recent unexpected development of agricultural production in the interior western region of the continent has a direct bearing on its future history, and will necessarily involve important commercial and political changes. Although a large development of meat products would naturally be looked for from the western plains, whose desert features have long since disappeared in the light of actual exploration, it would hardly be thought probable that western-grown wheat would find its way to a market in the Mississippi Valley and the eastern agricultural districts. Yet such a movement is now being plainly foreshadowed, and the time is not far distant when wheat fields ripened in the upper valleys, within sight of Rocky Mountain summer snows, will compete with less productive crops grown in Minnesota, Iowa, and Wisconsin. It has only lately been discovered that greasewood flats and, verdureless, baked clay bottom lands, when subjected to a judicious process of irrigation, will produce crops of forty, fifty, and sixty bushels of choice wheat to the acre, while the harvests are entirely secure from danger by fall rains, and the struggle with introduced foreign weeds and insects is as yet unknown.

One of the advantages of a dry climate is that the soluble mineral fertilizers of the soil are not washed out by constant rains, and thus transferred by running streams, to be deposited in river deltas for the benefit of distant geological eras, but are retained, subject to local demands, under an experienced system of irrigation. How far these facts may tend to modify the direction and scope of agricultural industry on this continent would hardly come within the range of a botanical report.

BENEFITS TO BE DERIVED FROM A NATIONAL HERBARIUM.

I may here call attention to the value and importance of a complete collection of our native plants, in an accessible form and scientific arrangement, as now designed in the herbarium of this Department, in connection with living specimens in the propagating gardens, greenhouses, and arboretum.

The great mass of facts connected with the various and multiplied forms of vegetation can be brought together for satisfactory comparison and study only in the compact form of dried specimens scientifically arranged. Imperfect as this may be in many respects, representing the living freshness of growing vegetation by the dried mummies of the herbarium, it is the only practical way of bringing side by side the widely scattered denizens of the field and forest, and of ascertaining the essential characters on which any suitable classification can be based.

The class of plants in which agriculture is especially concerned, namely,

the grasses and the grain producers, can be readily preserved in dried specimens so as to exhibit in a fair degree, not only the botanical characters on which classification is based, but also to give a correct view of their natural aspect.

Another view of the case is presented in the well-established fact that the natural vegetation of any country affords the clearest view of its agricultural capacity, as well as its climatic features. That which the geologist dimly deciphers, in the fragments of leaves impressed on rocky tablets, of the climate and vegetation of past ages, is more plainly manifested to us in the preserved specimens of the herbarium. Thus, from a complete set of the plants of any particular district, we can at once decide, with the least expense of time and costly experiments, to what class of agricultural products it is best adapted; where native grains, grasses, fibers, fruits, and timber can be most successfully supplanted by corresponding cultivated articles; and in thus directing agricultural toil to its surest reward, science takes its proper rank as the handmaid to labor.

ACKNOWLEDGMENTS.

In conclusion, I have to acknowledge my indebtedness to the following gentlemen for information and assistance in determining new or doubtful plants: to Professor John Torrey, of New York, in addition to his gratuitous labors previously mentioned, I am under special obligation for judicious advice in the arrangement and preservation of the general collection, as well as the determination of species in those families which he has particularly studied; to Professor Asa Gray, of Cambridge, Mass., for the identification of known species and descriptions of such as are new, and for advice and assistance in procuring works of reference and means of research; to Dr. George Engelmann, of St. Louis, Missouri, for determinations in the difficult family of plants which he has so thoroughly examined and largely illustrated; to Professor George Thurber, of New York City, for naming several sets of grasses from various western collections; to William S. Sullivant, of Ohio, for the determination of mosses; to Professor D. C. Eaton, of Yale College, New Haven, for the arrangement of ferns and the determination of doubtful species; and to Colonel S. T. Olney, of Providence, Rhode Island, for naming and arranging the *Carices* in the general collection.

It is only by the continued cordial co-operation of these living exponents of botanical science that the duties properly devolving on the botanist to the Agricultural Department can be in any measure satisfactorily fulfilled.

C. C. PARRY, *Botanist.*

Hon. HORACE CAPRON, *Commissioner.*

REPORT ON AGRICULTURAL METEOROLOGY.*

SIR: In response to your requirement I present the following as the result of my investigations concerning the "influence of climatologic agents, atmospheric and terrestrial, upon agriculture."

FUNDAMENTAL BASES.

There exists still a profound and lamentable disagreement, in most of our speculations, between the abstract sciences and the concrete sciences, or between theory and practice. A conception theoretically just is often in practice faulty. In this uncertainty the practicalists recoil from the assertions of theorists, and empiricism is indefinitely prolonged. Another vexatious circumstance which deters practicalists from serious studies, results from the fatal inaptitude of many theorists in the application of their discoveries. When they are forced to establish some relation between two or more sciences, the practical aim is entirely overlooked in a multitude of foreign considerations.

To throw a ray of light into this chaos, we must methodically systematize the phenomena corresponding to each science, and submit them to experimental proof. Then truth appears in all its clearness, and the most complex facts become the results of the simplest laws. It is then that the practicalist bows to the theorist, and science advances with a steady step.

I have adopted in this report the profound classification of sciences formulated in 1822 by Auguste Comte.† According to this philosopher, all knowledge is embraced in two orders of sciences. These are, the *abstract* sciences, whose object is the discovery of the general laws which regulate the divers classes of phenomena, and the *concrete*, or practical sciences, which consist of the application of these laws to living beings and inanimate bodies.

The abstract sciences are but six in number: Mathematics, astronomy, physics, chemistry, biology, and sociology, (the empirical politics of the day.) All other sciences are purely concrete, or practical. Such is the historical order in which these six sciences have successively appeared; such is also the dogmatic order in which only they could be classified,

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* The practical relations of meteorology to agriculture are not understood by farmers, and evidently only partially known, in the infancy of science, by the most advanced of its professors. The Commissioner of Agriculture, feeling the importance of the subject, commissioned Professor André Poëy, late director of the observatory at Havana, to report upon it; and Professor Henry, Secretary of the Smithsonian Institution, who has written much in this direction, thus indorses its practical value, while dissenting, as a member of a different school of science, from the definition of meteorology given by Professor Poëy.—[ED. REP.]

"SMITHSONIAN INSTITUTION, *April* 22, 1870.

"DEAR SIR: I have examined the accompanying report by Professor Poëy on meteorology as applied to agriculture, and although I do not subscribe to his definition of the science, nor to some of the extreme views he presents, yet I consider the report an elaborate exposition of the latest facts and speculations on the subject, which I think will be regarded both as instructive and suggestive by the agricultural community.

"I have the honor to remain, very truly, your obedient servant,

"JOSEPH HENRY.

"Hon. HORACE CAPRON,
"*Commissioner of Agriculture.*"

† Cours de Philosophie Positive. Paris, 1830–1842, 6 vols. 8vo. New edition published in 1864, with a preface by Littré.

and such even is the synthetic order of increasing complication of phenomena which each of these abstract sciences includes.

Each science becomes positive when all its phenomena are referable to fixed laws. Before this they are governed more or less by metaphysical principles, or by absurd prejudices. They are slower in reaching this positive state as the complexity of their phenomena increases, and their emancipation from metaphysics is the more rapid according to their simplicity. The simplest sciences are those comprising the most elementary phenomena, and whose laws are the most general, as in astronomy, which is entirely founded on the great law of universal attraction.

According as a science is intimately dependent upon a greater number of other sciences, and according, also, as the complexity of its phenomena increases, it requires an equal knowledge of the whole for the resolution of the least problem.

This is precisely the case with agriculture, which in part depends upon vegetable physiology, and this last upon vegetable anatomy; on the other side upon atmospheric and terrestrial meteorology, and this upon physics; then upon organic chemistry, and this upon inorganic chemistry. Such are the three double collateral sciences which directly influence the cultivation of plants. But simultaneously we must consider astronomy, botany, and geology, which advance parallel with vegetable physiology, meteorology, and organic chemistry. We can thus extend our sphere of comparative influences until it embraces the entire field of human knowledge. We now comprehend why agriculture as a science is so backward. The principal causes are its complexity and its tendency to routine. Let us, therefore, adopt a rational method in the art of American cultivation, and submit our hypotheses to rigorous experiment. Uniting thus precision with utility we make agriculture scientific, and at the return of each year we may have rich harvests.

Henceforth it is useless to fruitlessly exclaim against the impotence of science, if we do not procure it the means of acting wisely. Governments can never convert the funds of the state with more utility than in the increase of its agricultural products—the primary sources of national wealth.

I proceed, according to these fundamental bases, to the task of fixing the serious attention of agriculturists and horticulturists upon the principles and experiments which have enriched science within the last few years. I begin, so as to be understood, with the definitions which will be used in this report, of *agriculture*, *meteorology*, *climate*, *life*, and the *medium*.

Agriculture.—No definition yet proposed takes into account at once the three fundamental points constituting this science, namely, the organization of the plant, the influence of the atmospherico-terrestrial medium, and the agricultural product. Agriculture is a concrete science, that is to say, *practical*, because it draws in advance the scientific principles directly related to it from all the abstract or speculative sciences. As horticulture is the art of cultivating gardens and in-fields, so agriculture is, in the last analysis, the art of cultivation on a large scale—*grande culture*. The old definitions which have, besides, made agriculture consist of the cultivation of the soil, are still more erroneous, as it is, on the contrary, the plant which is cultivated under the conditions of tillage and atmospheric exposure most suitable to its production. I have, therefore, defined agriculture: "The concrete science which studies the vegetable organism under the influence of internal and external modifiers, and in its relations to the art of natural production."

Meteorology.—I have defined meteorology: "The concrete science which treats of the laws of atmospheric variations, in their relations to organized beings, as men, animals, and vegetables." From this point of view the name of *atmospherology* would be much more appropriate, as all the phenomena of the atmosphere are only variations of the physical and chemical properties of the dynamic forces which act through the air. None of these phenomena can be considered independently of each other, because they are always produced by some antecedent variation.

Climates.—I also propose the following definition: "Climates constitute the local and differential relations of the laws of atmospheric variations, in their actions upon organized beings, and in their reactions upon the inorganic medium." By this conception of climates we now perceive how the true relations existing between vegetables and the atmospheric agents have been hitherto based upon ideas wholly false. Hence the innumerable errors committed in the appreciation of climates, in accordance with the limits of temperature proper for foliation, flowering, and fructification, as well as the thermometrical degrees necessary for each physiological act of the plant. This error comes from having considered each individual plant as a kind of fixed thermometer, in place of looking at it as a true integrating machine, performing complex and continuous work.

Life.—According to the profound conception of Auguste Comte, life (animal and vegetable) results "from a double molecular motion, general and continuous, of composition and of decomposition, in relation to the organism and the inorganic medium."

The medium.—The notion of life supposes not only that of a being organized in such manner as to permit the phenomena constituting the vital state, but supposes further the not less indispensable idea "of the ensemble of external agents, physical and chemical, proper to furnish to the organism the principles necessary for its nutrition and the manifestation of the properties of its anatomical elements." This ensemble of conditions we name the *medium*.

The idea of life and that of the medium are two conceptions so inseparable from each other that no life is possible in a medium improper for the accomplishment of organic phenomena. There must be a certain harmony between these two media. As this harmony diminishes, the phenomenon passes from the normal state to that of sickness or perturbation, a prolongation of which occasions death. Organic perturbation may occur in three different modes, which it is important to fully understand before proceeding to analyze the nature of the perturbation.

1. If the medium is much more permanent, simpler, and more general, the living being alone is modified.

2. If the medium is much more unstable, more complex, and special, it is then more modifiable than the living being.

3. If the medium be as complex as the living being the modifications will correspond in both terms.

In the capital question of the reciprocal influence of climatologic agents upon living beings, and *vice versa*, the problem to be first resolved by way of experiment is the following: "To learn and separate, in meteorological observations, the sum of the actions of the medium, gravity, heat, light, electricity, &c., *favorable* for organic existence, from the sum of actions *unfavorable* for this existence, and, after this correction, to calculate the effects of action and reaction between the being and the medium."

This problem having been formulated by Alphonse de Candolle, solely with reference to the influence of temperature on vegetation, was ex-

tended by me, in 1857,* to all the other meteorological influences, by introducing the most capital element of the action of media upon living beings, and of their reaction upon media—a consideration overlooked by this savant.

The persistent harmony between vital forces and external modifiers, which concur in the phenomena of life, being thus established in the theory of media, the last problem remaining to be practically resolved is the following: "A living being and a medium being given, to determine their reciprocal influence."

Such is the course which I will pursue in examining those meteorologic and climatologic elements that exert any influence upon vegetable life, in its relation to the agricultural art.

THE CORRELATION AND CONSERVATION OF FORCES APPLIED TO THE VITALITY OF SEEDS AND GROWTH OF PLANTS.

In his president's address to the British Association for the Advancement of Science, (Newcastle-upon-Tyne, 1863,) the celebrated engineer, Sir William Armstrong, remarked that the new views on the correlation and conservation of forces constitute the most important discovery of the present century. According to this great principle we know, for instance how much mechanical force is needed for the production of a given amount of heat, and the converse. We thus express, numerically, the law of the invariable quantitative relation between motion and heat. When we appeal to experiment we find that raising the temperature of a given weight of water one degree of the Centigrade scale corresponds to the elevation of an equal weight to the height of 1,390 feet, or 772 feet for one degree of Fahrenheit's scale. This number is the *mechanical equivalent of heat*.

The principle of the correlation, conservation, and equivalency of heat and motion has been extended to all the forces both of organic and inorganic nature, and lately to the intellectual and moral functions. We thus identify all the forces acting in the living body with those acting in the inorganic universe, the former having only a higher degree of complexity.

Hence the organic constitution (animal and vegetable) may be compared to an engine in which heat is the principal agent. The power of the steam engine is derived from the heat applied to its boilers, which heat is but the expression of the chemical changes involved in combustion. The same with vegetable activity, the force of the solar light being used up in the decomposition of the carbonic acid of the atmosphere by the growing plant.† Combustion in the furnace of the steam engine is sustained either by wood which is the product of vegetation or by coal which represents the vegetable life of a remote geological epoch. In either case, therefore, we come directly or indirectly to solar radiation. But as Liebig says, our animated machines create no power, but only return what they have received from the external medium.

This ground was first taken in 1845 by Dr. Mayer ‡ in a remarkable essay in which he distinctly set forth the principle that the source of all changes in the living organism, animal and vegetable, lies in the forces acting upon it from without, while changes in its own composition

* Revue et Magazin de Zoologie, Paris, 1857, Nos. 8, 9; 1858, Nos 2-6.

† This was discovered by the genius of Sir John Herschel (afterward by George Stephenson) before the general doctrine of the correlation of forces had been given to the world by Mayer & Grove.

‡ Die Organische Bewegung in ihrem Zusenmenhange mit dem Stoffwechsel. Heilbronn, 1845., 8vo., pp. 112.

wrought by these agencies were the immediate source of the forces which are generated by it.

In 1850 Dr. Wm. B. Carpenter* aimed to show that the doctrine of the "Correlation of Physical Forces" propounded by Grove was equally applicable to those vital forces which must be assumed as the moving powers in the production of purely physiological phenomena; these forces being generated in living bodies by the transformation of light, heat and chemical action supplied by the world around, and given back to it again, during or after life, chiefly in motion and heat but also to a less degree in light and electricity. He suggests the probability of extraneous forces such as heat, light, and chemical affinity constantly acting upon the germ; so that all required is a structure capable of receiving, directing and converting these forces into those which tend to the assimilation of extraneous matter and the definite development of the particular structure. He shows how dependent the process of germ development is upon the presence and agency of external forces, particularly of heat, and how it is regulated by the measure of this force supplied to it.

THE VITAL FORCE.—From the highest antiquity innumerable theories have been proposed explaining the vitality which precedes the development of the germ, the reproduction and organization of living beings, animal and vegetable. That action has been successively attributed to an *entity*, a *principle*, an *agent*, or a *force*, acting on organic matter exteriorly or interiorly, or in both cases at the same time.

Professor Joseph Henry,† secretary of the Smithsonian Institution, thinks that "vitality is a *directing principle* and not a mechanical power, the expenditure of which does work. This principle, as an engineer, directs the power which is given out when a part of the oxygenized molecules runs down into inorganic matter, namely, carbonic acid and water, &c. By the term *running down* he means to indicate the passage of molecules from a state of less chemical stability to one of greater, which is the case in the passage of organic matter into inorganic matter. It is well known that organic matter is in a very soluble condition, while carbonic acid and water, into which it passes, possess a high degree of stability.‡

Dr. William B. Carpenter believes that "what the germ really supplies is not the force but the *directive agency;* that rather resembling the control exercised by the superintendent builder who is charged with working out the design of the architect. The vital force which causes the primordial cell of the germ first to multiply itself, and then to develop itself, is directly and immediately supplied by the heat which is constantly operating upon it and which is transformed into vital force by its passage through the organized fabric that manifests it. Thus heat, acting through the germs, supplies the constructive force or power by which the vegetable fabric is built up." §

There is evidently in this hypothesis of Dr. Carpenter a double error

* On the Mutual Relations of the Vital and Physical Forces, Phil. Trans., 1850, vol. cxl, Part II, pp. 727–757.

† Proceedings of the American Philosophical Society, June, 1843 to December, 1847, vol. iv, page 127–129. Reports of the Commissioner of Patents for 1857. Agriculture, p. 442–446.

‡ This definition was given me in writing by Professor Henry himself.

§ British and Foreign Medico-Chirurgical Review, 1848, p. 235. Phil. Trans., 1850, vol. cxl, Part ii, p. 727. Proceedings of the Royal Institution of Great Britain, 1858–62, vol. iii, p. 206, 209. New Quarterly Journal of Science, 1864, vol. i p. 76, 259, reprinted in Youmans's Correlation and Conservation of Forces, New York, 1869, p. 401–433. See also Edinb. New Phil. Journ., 1838, vol. xxiv, p. 327–352; British and Foreign Med. Review, 1843, vol. xv, p. 134, and 1851, vol. viii p. 237.

of idea and of facts. If the germ supplies not the force, but the directive agency, how can the force-heat supply to the germ the constructive force necessary to build up the vegetable fabric, unless the germ in itself could partake of the force of that heat? It would be, in other terms, a force acting on another force, without the latter being influenced by the first force. It is, in one word, an impossibility. As to the question of fact, the production of heat in the germ is, from its origin, at the same time, a cause and an effect, consequently it cannot be the primary cause of its development.

The decomposition, for example, of the carbon from the grain and its reconstruction in carbonic acid cannot take place without a chemical action and reaction, which, in both circumstances, produces heat. Which is the force that precedes here; is it the chemical, or the calorific action? We could just as well say that the chemical action is the constructive force of germs, and in that case we should come near the "running down" of Professor Henry, which is nothing but a purely chemical operation.

That which proves the non-identity between the vital force and heat, electricity or magnetism, is the experiments of Dutrochet on the circular movement of the sap in the cellules of the *chara*. He found that heat and electricity act on the circulation of the *chara* in the same manner as other forces called *exciting*, in diminishing its velocity, causing it to cease altogether, and establishing it anew. But the magnetic force, even when it is prodigious, does not exert any influence. From this, Dutrochet concludes that no relation exists between the vital force which produces the circulation of the chara, and that of heat, electricity, or magnetism.*

Joseph Le Conte, of South Carolina, has published ideas very similar to those of Professor Henry, with which he was acquainted before the issue of that gentleman's memoir, though he has made no mention of it. He advances the idea that the composition of the carbon of the seed and its combination with the oxygen of the air, to form carbonic acid, sets free a force by which germination is effected, and which suffices to organize the rest. "By the formation of carbonic acid," says he, "the seed loses weight, and decomposition and loss of weight is absolutely necessary to develop organizing force—the loss of weight being in fact the exact measure of that force. If an insoluble food be found capable of conversion into soluble form without loss of carbon, then germination of the seed might take place without loss of weight, by the direct conversion of the heat into vital force."†

Other authors, as Newport,‡ consider light as the primary source of all vital and instinctive power. Fowler§ thinks that not only vitality has correlation with all physical forces, but it is the artist of its own coils. Paget|| advances that every impregnated germ has in itself and in the properties with which it is endowed the power to develop itself, according to a law, into the perfection of an appropriate specific form,

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* Comptes Rendus de l'Academie des Sciences de Paris, 1837, vol. v, p. 775–784; Annales des Sciences Naturelles, 1838, vol. ix, p. 5, 65; Mémoires de l'Academie des Sciences de Paris, 1842, vol. xviii, p. 439–504.

† Proceedings of the American Association for the Advancement of Science, 1860, vol. xiii, p. 187–203; American Journal of Sciences, 1859, vol. xxviii, p. 305–319.

‡ The Athenæum, December 6, 1845; see Dr. Carpenter, Phil. Trans., 1850, vol. cxl, Part ii, p. 757.

§ Report of the British Association for the Advancement of Science, 1849, Part ii, p. 77–78.

|| Medical Gazette, London, 1849, p. 1014; see a refutation in the British and Foreign Medical Chr. Review, 1849, vol. iv, p. 411.

when the germ is placed in favorable conditions. "We may specialize it," says he, "as the *germ-power*, in consideration of its having its apparent origin and intensest action in the germ."

The great doctrine of correlation and equivalency of physical forces, as applied to vital forces, is not yet clearly understood. We must first bear in mind that the laws which preside over vital phenomena, moral or social, differ from the laws of physical and cosmological phenomena only in a higher degree of complexity, always increasing from nutrition to innervation and intelligence. They are only less and less simple, less and less general, and more and more subordinate to the action of a suitable medium. But these three orders of laws, physical, vital, and social, are by no means identical, and there is not even a gradation, nor an insensible transition from one to the other, as Darwin has supposed in his series of animals and vegetables.

The elementary properties of matter, according to circumstances, manifest themselves everywhere simultaneously, obeying the universal law formulated by Auguste Comte, of the *equivalence between the action and reaction*,* the manifestation of one exciting the manifestation of the other or of many others of the same kind. This law is already foreshadowed, and it is the one which we study to-day under the name of the law of the conservation, correlation, and equivalency of forces, or of the mechanical equivalency of heat, &c. Hereafter we shall arrive at the knowledge of the *mechanical equivalents of vital, intellectual, and moral forces;* then this law of solidarity, derived from the simultaneousness of action and reaction, will lead us naturally to the identity of all properties of matter—in other words, to the unity of forces. This unique force is perhaps *universal attraction*. It will be the beautiful ideal of science.

According to this principle, I proceed to explain the true source of vitality.

From the most distant suns and nebulæ to the smallest particle before our eyes, matter, unique and identical, everywhere reveals the same physical properties of gravitation, heat, light, &c., and the same chemical properties of composition and decomposition. These are properties *immanent* to matter created from all eternity.

Experience shows us to-day that from all the bodies which form the inorganic world there are but four principal ones which enter as integral parts of the weft of living beings, and these are oxygen, hydrogen, carbon, and nitrogen. But the fact that living beings are only formed of cosmical elements leads us to an important view in philosophy, that vital force is *immanent* to organized matter and inherent to the elements which enter its composition, on the same ground by which gravitation, heat, &c., are inherent.

One objects in vain that in the vitality of the germ the physical or chemical elements introduced in organic combination acquire new properties which they did not possess previously, as in the case of sulphuric acid, which shows properties different from those which belong to oxygen and sulphur. This objection would stand good if the new compound, sulphuric acid, should manifest properties different from the chemical one. But it is only a transformation of the elements into another chemical element more complex. The same, the elements susceptible of organization, show but equal vital properties in the transformation into other vital elements more complex and less unstable to form vegetable and animal organisms. Consequently, we cannot say, as Dr. Car-

*Judging from the law, Auguste Comte may be considered as having made the first step toward the foundation of the doctrine of the correlation and equivalence of forces.

penter would do, that "heat is transformed into vital force by its passage through the organized fabric."

Müller has very well shown that in the germ the force of evolution reaches its highest power; the nearly microscopic impregnated ovale becomes a body considerably larger; when it leaves the bosom of its parent the evolution is much less rapid; it is still less from infancy to puberty; at the adult state evolution arrests itself, and only makes up its own losses, and finally it ceases to compensate these losses; organic degeneration commences, until it becomes an impossibility to be, according to the philosophic expression of Fontenelle.*

As observes Littré, "This evolution can be well represented by the curve of a projectile, whose movement is most rapid at the moment of departure, decreases gradually, and ends by stopping altogether. As the force of projection has *space* for its domain, and the projectile is aimed at a certain point, the force of life has *time* for its domain, and the germ is aimed at a certain term of duration."†

The duration of life is further subjected to the physical laws which govern our projectile; for it is an axiom in physics that movement once begun would last forever if it were not at last destroyed by the resistance it encounters. The vital force or the life also would last indefinitely if it were not destroyed by its resisting medium. This medium is the molecules which are constantly added to and taken from the organism, and which constitute nutrition in the double motion of composition and decomposition, thus offering to us the true definition of life. But this medium being double, that of the cosmological world affects principally our physical organization, and the other in the social world influences principally our moral nature. So the cause of natural death is the resistance of the molecular medium. The source of life is also the source of death. Of the three fundamental activities of matter, nutrition, mobility, and sensibility, a great number of living beings, such as vegetables, do not possess the two last, and still die by natural death. The phenomenon of natural death is then *exclusively* affixed to the phenomenon of life by the movement of composition and decomposition which constitutes nutrition.

It may still be objected that if vitality consists in the immanence of organic matter itself, why does not life spring from all the possible combinations of that matter. It is in this capital question that the immense influence of the medium on the development of the germ is shown by the following solution: An isolated inorganic molecule does not manifest certain essential properties; for example, does not show any electric or magnetic action unless it is placed beside another molecule, under the conditions of influence and reciprocity necessary to those effects. Similarly, in the state of isolation, another molecule will not seem to own any affinity of combination without the required contact, immediately on which the chemical action appears. It is exactly what happens with the isolated organic molecule, which will not develop its vital forces unless it be placed in a convenient medium for this new manifestation.

"The duality," says Littré, "brings in evidence properties immanent to matter, and does not create them." In the supposition of Dr. Carpenter, the germ would have created a new force, at least a new property, by the transformation of the calorific into vital force. The principle of the transformation of forces is not well understood by a great number of philosophers, for there is no transformation of forces, properly speaking, but a dynamic *equivalence* of all the forces of nature.

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* The philosopher Fontenelle, dying at the age of 99, when asked what he felt, replied "Une difficulté d'être," (a difficulty to be.)

† Revue de Philosophie Positive, Paris, 1868, vol. ii, p. 194.

The properties of life are essentially chemical, as they consist in a continuity of composition and decomposition; the same, at the moment when any chemical combination takes place, a change happens analogous to life. The only difference is, that in chemical action the phenomena are instantaneous, and the body becomes again completely inert, while in every organism it renews itself as long as the movement of composition and decomposition lasts. All organized bodies placed in a suitable medium present the double movement which characterizes life, by the increase (nutrition) and decrease of its anatomical elements. So the vital force is not a cause; it is, on the contrary, an effect, a *modus operandi*, an immanence, in one word, the *law* of organic matter, as universal attraction is an immanence and the law of inorganic matter. The phenomena of vitality are therefore but *properties of tissue*, which are reproduced afterward in each anatomical element.

It is by not distinguishing these physiological properties from those purely physical and chemical that many savants have attributed the vital force to heat, light, chemical action, &c., without distinctly perceiving that each one of these forces is correlative and developed simultaneously in all the manifestations of organic and inorganic matter. Although some of these predominate in certain circumstances, they are no more the cause than the effect one of the other. For example, electricity produces magnetism, and this in turn engenders electricity.

We must, therefore, well determine, as the positive school has also done in the phenomena of vitality, the character which distinguishes the three fundamental properties or activities of matter, which are, first, the physical properties of matter considered as a whole, in which the atomic disposition remains *invariable*, as in gravitation, heat, light, &c.; second, the chemical properties which embrace beside all the physical properties, those of composition and decomposition, by modifying the atomic disposition by the aid of *binary* connection; third, the vital properties, where all the physical and chemical properties of matter are complicated with the phenomena of life; that is to say, with the continuity of movement, the composition and decomposition which constitute nutrition. After such a distinction it is impossible to confound the *physical* properties of matter with the *chemical* and *vital* properties.

If I have extended these remarks on the capital question of the correlation and equivalency of forces physical and vital, it is not only because the subject is new and ill understood, but because of the important application which can be made of it to agriculture. When the correlation of all these forces is well understood, agriculture will be able to direct them according to its wants, to the high profit of culture. I shall mention a striking fact which confirms this assertion: the method of propagating plants by cuttings adopted by the able horticulturist, William Saunders,* superintendent of the experimental garden of this Department. As we apply heat or cold to one of the two extremities of the cuttings, we obtain buds and leaves, and roots at the other, directing and concentrating the vital force at pleasure.

INFLUENCE OF THE SOLAR SYSTEM UPON VEGETABLE LIFE.

Static and dynamic astronomy plays in meteorology a part of the highest importance in relation to animal and vegetable life.

It is incontestable that the total duration of life, and that of its principal natural phases, necessarily depend upon the proper angular velocity of our planet's rotation, which varies with the latitude. Auguste Comte

* The Horticulturist, New York, 1860, vol. xv, p. 22–23, 59–60, 154–157.

* Aug. Comte, Cours de Philosophie Positive. Paris, 1838, vol. iii, p. 623.
† Elements of Agricultural Chemistry. London, 1814, p. 31 and 1 pl. Collected Works, edited by John Davy, M. D. London, 1840, vol., vii, p. 200, Plate I.
‡ De La Hire, Mémoire de l'Académie des Sciences de Paris, 1703.

has very well remarked, other things being equal, "that the duration of life must be less prolonged," especially in the animal organism, "as the vital phenomena succeed each other with more rapidity."

In the equatorial regions, for instance, where the earth's rotation suffers a certain acceleration, the course of the principal physiological phenomena also suffers a corresponding acceleration. Hence results necessarily a diminution of the duration of life at the same time with a vegetation more luxuriant and vigorous than in the temperate or frigid zones, by the power of the dynamic forces, which act mechanically, physically, and chemically. Thus the angular velocity of the earth's rotation, united to the duration of life, is wholly inseparable from the duration of day and night.

Animal and vegetable life must suffer the same influence in the other movement, that of the earth's translation around the sun, relative to the different degrees of eccentricity of the terrestrial ellipse. The inclination of the earth's axis to the plane of its orbit produces, moreover, divisions of climate, whence results the law of geographical distribution of living beings, animal and vegetable.

All these astronomical considerations, and others too numerous to mention, must certainly be taken into account in a systematic and scientific study of agriculture. The atmospheric variations of the mechanical forces, physical and chemical, must then be examined in relation to their geographical distribution together with the essential conditions of topography and the distribution of continents, while all must be relative to the vegetation of the latitudes under consideration.

The decrease of mean temperatures, for instance, from the equator to the pole, which depends upon the action of the sun, modified by the configuration and relative positions of the continents, is the most rapid in the two worlds between the parallels of 40° and 45°. Observation, adds Humboldt, offers on this point of climatology a result entirely in harmony with theory; for the variation of the square of the cosines, established by Sir David Brewster, as expressing the temperature, is the greatest possible at the 45° of latitude. In the system of climates of Western Europe the annual mean temperature, corresponding to this latitude, is from 13° C. to 13.5°, and the coldest reaches there, moreover, 3° to 4° of mean heat. It is the beautiful and fertile zone, traversing the south of France (between Valence and Avignon) and Italy, (between Lucca and Milan;) it is the zone in which the region of the vine touches that of the olive and citron. In no part elsewhere, in advancing from north to south, can the temperatures be seen to increase more sensibly; in no part, also, do the vegetable productions and the varied objects of agriculture succeed each other with more rapidity.*

The variations suffered by the law of the squares of the cosines at the 45° of latitude, where the increase of temperature corresponds with a rapid vegetation, confirms for the whole globe the observation which will be cited further on from Quetelet, as to the favorable influence of extreme variations of heat, within certain limits, upon the development of plants. It will be important to verify this law in the agricultural products of the United States.

ACTION OF GRAVITY UPON VEGETABLES.

Among the purely physical influences of the terrestrial medium we

* Humboldt, Mémoires de la Soc. d'Arcueil, 1817, vol. iii, p. 504; Fragmens de Géologie et de Climatologie Asiatique, Paris, 1831, 8° vol., pp. 494–496.

must place in the first rank the action of gravity, which intervenes in a notable and direct manner in vital phenomena, to which it may be sometimes favorable, at others the reverse, but almost never indifferent. This inevitable co-operation constitutes an important subject of biological researches, hitherto merely outlined.

In inferior organisms and chiefly in those of the vegetable kingdom, says Auguste Comte, the physiological action of gravity is much less varied, but also much more preponderant and sensible, in consequence of the less complexity of the vital state, according as it approximates the inorganic state. The ordinary laws and the general limits of the growth of vegetables appear to depend essentially upon this influence, as has been verified by the ingenious experiments of Knight upon germination modified by a more or less rapid rotation. Organisms still more elevated are subjected to analogous conditions. For there is almost no function, organic, animal, or even intellectual, in which we cannot point with certainty to a general and indispensable intervention of gravity, which is specially manifested in what concerns the stagnation or movements of the fluids.*

"The great operations of the farmer," says Sir Humphry Davy,† "are directed toward the production or improvement of certain classes of vegetables; they are either mechanical or chemical, and are consequently dependent upon the laws which govern common matter. Plants themselves are, to a certain extent, submitted to these laws; and it is necessary to study their effects in considering the phenomena of vegetation. Gravitation has a very important influence on the growth of plants; and it is rendered probable, by the experiments of Knight, that they owe the peculiar direction of their roots and branches almost entirely to this force."

Among the numerous phenomena presented by vegetables, says Aug. Pyr. de Candolle, there are few that have a juster claim to excite attention than that of the regular direction affected by plants in certain of their parts. The roots tend to descend and the stalk to ascend with more or less velocity. This double faculty is manifested from the very birth of the plant, and is preserved throughout its whole life. In whatever direction we place a seed, its root on leaving its envelope, is directed toward the earth and its stem to the sky. Turning the young plant upside down as Duhamel has done, each of its two organs is reversed, but it takes again the direction which properly belongs to it.

Some naturalists, such as Percival, Johnson, &c., have assimilated this phenomenon to animal instinct, or Lefébure to the direct action of the vital force. Doclarts believed that the fibers of the radicle were contracted by humidity, and those of the germ by dryness, forgetting that the same thing took place in the open air as in the earth and in the shade as well as in the sun. Others have referred this phenomenon to the nature of the sap, as De la Hire,‡ or as Darwin to the living powers of the plant, and the stimulus of the air upon the leaves, and of moisture upon the roots.

Wishing to see how a bean would grow if kept in a constant rotary motion, John Hunter made the first experiment which has led to the true explanation of this physiological act of the plant. He then saw that the roots and the plumules were guided in the direction of the axis of rota-

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* Aug. Comte, Cours de Philosophie Positive. Paris, 1838, vol. iii, p. 623.
† Elements of Agricultural Chemistry. London, 1814, p. 31 and 1 pl. Collected Works, edited by John Davy, M. D. London, 1840, vol., vii, p. 200, Plate I.
‡ De La Hire, Mémoire de l'Académie des Sciences de Paris, 1703.

tion.* When this axis is very slightly inclined, for example, a degree and a half, Dutrochet† has seen even with so small a quantity the radicles directed from the lowest side, and the germs from the side which tends to rise.

These first essays have given place to a decisive experiment of Knight, which furnishes the true explanation of this phenomenon. He fixed some seeds of the garden bean in the circumference of a wheel, which in one instance was placed vertically and in the other horizontally and made to revolve. They were supplied with moisture and placed under circumstances favorable to germination. The beans all grew, notwithstanding the violence of revolution, which was sometimes as many as two hundred and fifty turns in a minute with the vertical wheel. The radicles, or roots, pointed precisely in the direction of the radii, in whatever position they were first placed. The germs took precisely the opposite direction and pointed to the center of the wheel, where they soon met each other. Upon the horizontal wheel, the conflicting operation of gravitation and centrifugal force occasioned the germs to form a cone, more or less obtuse according to the velocity of the wheel, the radicles always taking a course diametrically opposite to that taken by the germs, and, consequently, pointing as much below as the germs pointed above the plane of the motion.

"This effect is now shown," says Sir Humphry Davy,‡ "to be connected with mechanical causes; and there seems no other power in nature to which it can with propriety be referred but gravity, which acts universally, and which must tend to dispose the parts to take a uniform direction. If plants in general owe their perpendicular direction to gravity, it is evident that the number of plants upon a given part of the earth's circumference cannot be increased by making the surface irregular, as some persons have supposed. Nor can more stalks rise on a hill than on a spot equal to its base; for the slight effect of the attraction of the hill, would be only to make the plants deviate to an inappreciable extent from the perpendicular. Where horizontal layers are pushed forth, as in certain grasses, such as the *fiorin* lately brought into notice by Dr. Richardson, more food may, however, be produced upon an irregular surface; but the principle seems to apply strictly to corn crops. The direction of the radicles and germens is such that both are supplied with food and acted upon by those external agents which are necessary for their development and growth. The roots come in contact with the fluids in the ground; the leaves are exposed to light and air; and the same grand law which preserves the planets in their orbits is thus essential to the function of vegetable life."

The time will come in agriculture when by means of some ingenious contrivance applying the law of gravitation cultivators can give to trees and shrubs such forms as suit their fancy.

ACTION OF ATMOSPHERIC PRESSURE UPON VEGETABLES.

After the physiological study of gravity we must naturally place the examination of the purely mechanical conditions of general pressure exerted upon the vegetable organism by the inorganic medium. Atmospheric pressure is here only an indirect result of gravity, regarded as acting upon this medium and not on the organism. The general existence of every living being, not excepting man, is necessarily included

* John Hunter's Works, edited by James F. Palmer. London. 1837, vol. iii, p. 286.
† Dutrochet, Recherches, &c., p. 146.
‡ Collected Works, vol. vii, p. 201-202, Plate I.

within certain limits, more or less extended, of the *barometric scale*, outside of which we cannot conceive its continuance. Unhappily our ideas in this respect are altogether confused with regard to the inferior animals, and especially to the vegetable organism. While observers are almost exclusively occupied with the physiological effects due to sudden changes of pressure, they have examined very slightly the more interesting influence and perhaps distinct quality of the gradual variations.*

Pressure, as applied to the law of organic form in physical morphology, plays an active part. James Hinton has endeavored to show that as motion takes the direction of least resistance, therefore organic form is the result of motion in that very same direction. The formation of the root forms a beautiful illustration of the law of least resistance, for it grows by insinuating itself cell by cell through the interstices of the soil, winding and twisting wherever the obstacles it meets in its path determine; and growing there most where the nutritive materials are added to it most abundantly. In those cases in which *fungi* grow up under great pressure, which they overcome, the opposition to the law of least resistance is here only apparent. The plant is altered in form in proportion to the pressure on it, if it is great; and manifestly the pressure is overcome precisely when the resistance to growth in any other direction, arising from causes in its own structure, becomes greater than such pressure. Throughout almost the whole of organic nature the special form is more or less distinctly marked. Now, motion under resistance takes a spiral direction, as may be seen by the motion of a body rising or falling through water. The motion of the falling body being resisted, is deflected or turned at right angles, and a motion constantly turning at right angles and still continuing, is a *spiral*. A bubble, for instance, rising rapidly in water describes a spiral closely resembling a cork screw.† This is also the case with climbing plants.

I had thought that the movement of the sap might be influenced by the attraction of the moon and sun as well as by the atmospheric pressure, as is the case with tides and the barometer. But the celebrated physiologist Hales‡ has already discovered a diurnal movement of the ascension of the sap in vines which was considerably influenced by heat, humidity, rain, mist, dew, &c. The results at which he has arrived are these: When the day is warm, the sap falls from nine to ten o'clock in the morning, and if the weather is fresh and damp, it falls from eleven to two o'clock; it is stationary for one or two hours, after which it rises insensibly from two to six in the afternoon; during the night it rises very little, but its most rapid ascension is from sunrise to 9.30 in the morning. The experiments of Hales were somewhat discordant in different vines and periods. He attributed these oscillations to the heat, which increases the transpiration of the plant, and causes the sap to fall. We notice here a discord between the movements of the sap and the atmospheric pressure, for the sap is lower when the barometer is higher, from 9 to 10 in the morning, and is higher when the barometer is lower, from 4 to 5 in the afternoon. It is important to study the relations which exist between these two phenomena by new experiments made in better condition. At present, an application of these facts to the hours favorable for grafting would be of use to horticulturists.

* Auguste Comte, Cours de Philosophie Positive. Paris, 1838, vol. iii, p. 624.
† The British and Foreign Medico-Chirurgical Review, London, 1858, vol. xxii, p. 482.
‡ La Statique des Végétaux, etc., Paris, 1779, pp. 84, 100.

HOW TO CALCULATE THE TEMPERATURE FAVORABLE OR UNFAVORABLE TO VEGETABLES.

There is in vegetable physiology an important law, which renders the growth of plants, within suitable limits, more rapid as the heat is more intense, while their earlier or later arrival at a complete development is the result of continued accumulation of heat. This circumstance permits the cultivation of plants useful to man in very different climates.

This law has been thus expressed by Babinet: "Every plant, after a fixed temperature, requires the same quantity of heat to be equally developed."*

Charles Martins† and Quetelet believe that plants are true thermometers having the property of indicating not the present temperature, but the sum of previous temperatures. "It is in some degree," says Quetelet, "an instrument of integration, which preserves at once an account of the heat and of its duration."‡

Alphonse de Candolle,§ on the contrary, asserts that a plant is not an instrument like the thermometer; it is rather a kind of *machine* performing work, and very varied work, under the impulsion of external agents, as heat, humidity, &c., and of an internal agent, life, which is difficult to ignore in explaining this phenomenon. If the functions accomplished by the plant afford a measure of heat, it is only in an indirect manner, modified by a multitude of secondary causes.

In the case of a simple machine the whole effect produced indicates the power applied. But natural machines, as plants, are much more difficult to study and more irregular in their progress, since the forces which they operate are numerous, the details of their organization in part unknown, and the products of their work, that is to say, the leaves, flowers, fruits, seeds, fecula, sugar, and other materials, are very numerous and varied. A certain minimum of heat will be necessary for germination, another for this or that chemical modification, a third for flowering, &c.; then there must be a certain sum of heat for each function, a certain intensity of light for the plant to become green, and a certain quantity of water for the greater part of the phenomena.

All this is complex, but it is the only just point of view. The plant is not at all influenced by external agents, as the thermometer by temperature or the hygrometer by humidity. There is an immense difference. Below a determined temperature the plant produces nothing, nor does it give any sign of life, while the liquid of a thermometer is always rising or falling. Every time the heat diminishes, the thermometer falls back; on the contrary, the plant, like a true machine, never destroys what it has produced. It may be arrested in vegetation, but the germ never returns to the seed, the leaf never returns to the bud, nor the flower to the stem. What is produced is produced. We must, therefore, estimate its progress by an entirely different process and challenge the comparisons which may be established between the external phenomena, measured by physical instruments and the phenomena of vegetable life.

De Candolle believes, in a word, that the comparison of vegetables to thermometers is proper only so long as they act on the initial temperature required by each species; this point of departure being a kind of thermometrical zero. But in its ulterior developments and in its en-

* Comptes-Rendus de l'Académie des Sciences de Paris, 1851, vol. xxxii, pp. 521, 524.

† Voyage Botanique en Norvège; extrait des voyages en Scandinavie et au Spitzberg de la corvette La Recherche. Paris, 1848, vol. ii.

‡ Bulletin de l'Académie des Sciences de Bruxelles, 1855, vol. xxii, Part I, p. 12.

§ Géographie Botanique raisonnée. Paris, 1855, vol. 1, p. 2.

semble, the plant is comparable to a machine which may be put in operation by certain temperatures, by light and other atmospheric agents, and which never destroys what it has produced. This comparison shows that to estimate the effects of heat on the vegetable kingdom we must always have—first, the temperature which can produce an effect; second, the intensity of the temperature; third, its duration.

The simplest observation in agriculture and horticulture, adds Alphonse de Candolle, renders it evident that time and heat are united in producing the phenomena of vegetation. When a month has been colder than usual, it is sufficient that the following month be warmer, in proportion, in order that the mean may be re-established for the time of the crops or their quality. The process of *forcing* plants, in horticulture, is a rigorous application and an habitual demonstration of the same principles. If the light remains suitable, by combining heat and time, we advance or retard according to desire the flowering and maturation. We can make them even appear upon a fixed day when we skillfully use these two means. The possibility of cultivating a plant in a certain season, and the ability of a species to live in a country or to a certain height on the mountains, depend almost always on heat and its duration.

Thus a certain maximum of heat or a certain minimum of cold is necessary for germination; another for leafage, flowering or fructification. This principle is fully established. But at the beginning how can we fix the temperature which causes the plant to advance from its germination to its fructification? At what point does the plant commence its functions? Is it from the point of melting ice? For the greatest number of plants, the temperature becomes active when it is above zero, as the liquids enter into circulation, and we can count the effective degrees. This point is not by any means the same for all plants.

How, then, to combine the two inseparable values of temperature and its duration—*force*, *space*, and *time?* In other terms, following De Candolle, what is the temperature proper for vegetables? How can we disengage this in our meteorological observations from the temperature improper, and, after this correction, calculate the effects?

Since 1735, after Reaumur* had arranged his new thermometrical scale, he thought that for each vegetable species a certain amount of heat was necessary, in order to flower or fructify, below which neither of these two great physiological functions can take place. This fact confirmed, a great difficulty presented itself, and is not yet resolved, in relation to the mode of determining exactly the amount of heat which vegetation receives.

Three methods of calculation have been proposed: The first and most natural is that of Reaumur, followed by l'Abbé Cotte,† Adanson,‡ Gasparin,§ Boussingault,‖ De Candolle, and others. This method consists in multiplying the mean temperature of each day by the number of days that the plant takes to accomplish the proposed physiological function, either germination, foliation, flowering, or fructification. It is arithmetical proportion, supposing that the progress of vegetation is in relation to the simple number of degrees of temperature.

The second method of computing the degrees of vegetable temperature was proposed by Quetelet, director of the observatory at Brussels. According to this savant, heat acts upon vegetation after the manner of

* Mémoires de l'Académie des Sciences de Paris, 1735, p. 559.
† Traité de Météorologie: Paris, 1774, p. 422.
‡ Mémoires de l'Académie des Sciences de Paris, 1778, p. 428.
§ Mémoires d'Agriculture, &c., 1855, Part I, p. 239.
‖ Comptes-Rendus de l'Académie des Sciences de Paris, 1837, vol. iv, p. 178.

living forces, (*vires vivæ*,) that is to say, that its action is proportional, not to the sum of the simple degrees, but to that of the squares of these degrees. For example, two days in spring with a temperature of 10° should not produce the same effect as a single day with a temperature of 20°, the last giving an effect double the other two, assimilating the action of heat to that of living forces. Here it is a proportion which supposes the progress of vegetation in relation to the squares of the degrees of temperature.

From very many observations upon periodical phenomena, made since 1839, Quetelet is moreover convinced that plants are developed more rapidly during the same mean temperature, when the heat varies, than when it remains uniform. But these variations must be considered only above the freezing point. Thus a uniform temperature of 10° will produce less effect than a mean temperature of 10° varying between the limits of 6° to 14°, the effects will be as 100 to $\frac{36+196}{2} = 116$. *

The extreme temperatures, according to Quetelet, cannot pass certain limits; it is the same with the mean temperatures. It is not sufficient, indeed, that a plant has received a certain amount of temperature or of the squares of temperature in order that it may flower; this amount must besides have attained a certain degree of elevation, below which flowering cannot take place. In order to produce, says Humboldt, drinkable wine on a large scale, there must be not only a mean annual temperature of 9° or 9°.8 C., which does not fall in winter below 1° or 1°.5 C., but especially must there be a summer heat which exceeds at least 18°.5 C. Experiment alone can teach us how far the influence of this mean reaches. The buds of a plant, which blossoms only under a temperature of 15° C. will die under a temperature constant at 14° C.; while it will be covered with blossoms under a variable heat from 12° to 16° C. At 12° it will exhibit no development, but at 16° it will blossom and preserve its buds in flower even after the temperature has been lowered a little.

In fine, the third method of calculating the temperature proper for vegetables is due to Babinet.† This savant bases it upon the fact that a constant natural force, as gravity, is proportional to the intensity of the cause multiplied by the square of the time during which it acts. By considering heat as a living force, and applying this principle to the effect of temperature upon vegetables, he recommends the multiplication of the mean of daily temperatures by the square of the number of days during which it acts upon the vegetable. But this method which rises to the square root of the temperatures, has not been submitted to experiment, and De Gasparin ‡ has refuted it by some comparisons with his own method and that of Quetelet on the vegetation of lilacs and other plants, of 1782 and 1790.

We see how savants disagree about the calculation of the dynamical action of efficient temperatures upon vegetables. This discord is yet greater when we consider that they differ no less upon the point from which we should begin to count these temperatures either above or below congelation, and which constitutes the point of the plant's revival. It is, however, there that they should begin, as the base of calculation. Reaumur, Cotte, and Adanson, for instance, in their manner of counting, refer it to an arbitrary period, such as the first of March; Cohn and Fritsch propose the twenty-first of December, the time of the winter solstice. Boussingault determines the temperature between the birth

*Annales de l'Observatoire de Bruxelles, 1861, vol. xiii, p. 326.
† Comptes-Rendus de l'Académie des Sciences de Paris, 1851, vol. xxxii, p. 521.
‡ Mémoires d'Agriculture, Part I, p. 237.

of a plant and its maturity, and takes the amount of heat which ripens many plants, particularly cereals, counting from the time frosts cease, which he fixes for Paris and the north of France on the fifteenth of February, and for the south on the first of that month. De Gasparin begins with the time of the evolution of the bud, which he considers zero of the scale of temperature in plants. Quetelet takes a natural epoch, such as the revival of the plant, after the rigors of winter; or from the day when the mean temperature, after the great cold of winter, becomes in a manner stationary above the freezing point. Even then, adds he, we do not take into account the temperature from the end of the preceding year, which has served in part to elaborate the leaves and flowers, developed by the earliest heats. We do not regard the greater or less rigors of winter, which may have attacked the plant's constitution; we also neglect a *maximum* of temperature, which each plant requires to develop its corolla and to open its stamens.* He, therefore, proposes to take into consideration at the same time, anterior temperatures by the introduction of a *constant.*

The introduction of this constant, adds Quetelet, allows us to count the effects of temperatures from any point. The time of the cessation of severe frosts and the apparent revival of plants is more easily seized, but we are not sufficiently acquainted with the action of cold upon them. It appears that when the temperature descends only one or two degrees below zero, and that not permanently, it produces no retrograde effect. If the cold, though moderate, is continuous, it plunges the plant into its winter sleep; if it is yet more continuous and excessive it will destroy even the beginnings of vegetation, and the plant will be found less advanced than at its first revival. In fact, new buds of leaves and flowers must be formed in order to supply those killed by the last frosts. But we do not know the degrees of cold which characterize these different processes. Quetelet believes it then preferable to throw back the period whence we count the temperatures, and to admit a provisional constant. It seems evident, says he, that very intense cold produces negative effects, which should be taken into account.†

In fine, Pouriau takes the mean of temperature from seed-time to harvest, multiplying it by the number of days between. "We arrive thus," says De Gasparin, "at numbers much higher as we attribute to winter days, which are very numerous in the cycle, the means deduced from the temperatures of winter and summer."

The objections which have been made to each of the methods mentioned above for calculating the temperature proper for vegetables have small scientific value, since the observers have not regarded either the plant or the degrees of the thermometer used, from the same point of experiment or theory. Dr. Ferdinand Cohn, who has discussed the observations of the Silesian Society of Breslau, was the last to raise difficulties against the three methods of Adanson, Quetelet, and Babinet. Quetelet has answered him, proving that the argument which he employed against the method of the squares of the temperatures for estimating the development of plants has no value. He closes by saying that he has submitted his method to experiment with success upon a great number of plants growing in the open air and in green houses. Karl Fritsch,‡ at Vienna, obtained similar success. They have even been able, by temperatures previously calculated, to cause plants to flower

* Sur le Climat de la Belgique, Bruxelles, 1849, 2d Partie, p. 7.

† Bulletin de l'Académie des Sciences de Bruxelles, 1855, Part I, p. 15.

‡ Denkschriften der Kaiserlichen Akademie der Wissenschaften, 1858, vol. xv, pp. 85–180.

on the day, and in some cases at the hour, indicated in advance. Some plants are shown to be rebels, such as the autumn *Colchicum*. Moreover, Cohn admits that Quetelet's theorem, which sums up the squares of the temperatures, gives more satisfactory results, and that the theorems of Adanson and Babinet are inadmissible. But the fact that mathematics is at present unable to resolve this difficult problem of determining the functions on which the development of plants by heat and other external influences depends, is certainly no reason, as Cohn thinks, for renouncing the comparison of relations of temperature with those of vegetation.

Heat is accumulated from day to day, says Alphonse de Candolle, and the quantities added together finally form a considerable amount. What is wanting in these circumstances is not, therefore, heat in general, but heat above a certain degree.

Charles Martins has worked up these ideas in an irrefutable manner. "All plants," says he, "do not enter into vegetation at the same temperature; in some, the sap commences to rise when the thermometer is only a few degrees above zero; others need a heat of from 10° to 12°; those of warm countries require a temperature from 15° to 20°. In a word, each plant has its own thermometer, the zero of which corresponds to the minimum of temperature where its vegetation is possible. Consequently, when we are seeking the sum of the temperatures, which determines the flowering of each plant, it is logical to take only the sum of the degrees of temperature above the zero of each, since these are alone effective to provoke or support their vegetation. We then obtain a true expression of the heat indispensable to the development of leaves or flowers. But when we take, as a point of departure, the freezing point of water, we add degrees of temperature too near the thermometrical zero to stimulate growth to those which may really develop it." M. Martins adds that Arctic and Alpine plants are the sole exceptions, their vegetation commencing with the temperature about 0°, after the snow has liquefied.

From these considerations, we see that the temperature proper to each vegetable, for each of its physiological functions, as well as in the applications of meteorology to agriculture and botanical geography, are, for each locality, the sums of temperatures above 0°, + 1°, + 2°, + 3°, &c., according to the species considered. These temperatures, by accumulating during days, months, and years, form in time, in each locality, the divers sums which constitute the characteristic elements of climates in regard to the physiological functions of vegetables.

These reflections, adds De Candolle, are of such force that we fear we can never employ thermometrical observations used in the ordinary way, to explain the phenomena of vegetation. We must have, in place of the means and extremes as they are given, for each month or period under examination, "the number of hours during which the thermometer remained above 0°, then above 1°, 2°, 3°, &c." We must, in addition, learn by positive experiment if the same degree of heat produces the same effects night and day, which is not likely, and if a continuous heat produces the same effects as an intermittent heat, which is also improbable.

The question thus laid down by modern science tends to nothing less than a complete reversal of the present system of meteorological observations and tables, in their applications to physiology, agriculture and horticulture. It will have, as a consequence, the reference of physiological phenomena to the sums of the temperatures above each degree proper to vegetation, and not to means more or less arbitrary, at once

in their points of departure and their values. This new method, observes De Candolle, will require either the employment of new instruments, such as the pendulum of M. Edmond Becquerel, with certain modifications, or at least a mode of presenting the thermometrical numbers absolutely different from that now used.

Another system would be that of the *thermometrograph*, marking the temperatures above a given degree, and only those. The photographic process now in use for the observation of the barometer and thermometer seems to afford facilities for the realization of this idea.*

INTERNAL HEAT OF VEGETABLES.

In the tissues of living bodies a multitude of chemical processes are constantly going on, engendering a certain heat, which in warm-blooded animals constitutes their *temperature proper*. But in cold-blooded animals and in vegetables, this chemical production of heat being very feeble, the temperature which they have comes principally from the ambient medium; not only from the air but also from the water, charged with different elements, which is sucked up by the roots in order to form the sap.

Like that of the air, the temperature proper for vegetables is submitted to periodical variations, only its amplitude is much less extended. This heat is liberated in the leaves, organs of respiration, in the flowers, organs of generation, as well as in the green parts of vegetables. In the phenomena of nutrition, the ascent of sap cannot be effected without a slight production of dynamic heat, nor afterward can its elaboration in the leaves, under the influence of light, take place without chemical reactions, and consequently without another liberation of heat. In fine, the whole of these chemical reactions are always accompanied by the production of heat, whose influence upon the vital functions of the plant we have not yet been able to appreciate. This estimation becomes the more difficult, as the production of vegetable heat is accompanied by many effects of cooling, such as evaporation from the leaves, liberation of oxygen, arising from chemical reactions which take place under the influence of light, and from which results a disengagement of carbonic acid.

The first experiments undertaken to determine the temperature of the internal parts of vegetables do not go back much beyond eighty years. At that time thermometric observations did not possess that degree of exactitude which they have since acquired. None of the precautions necessary to protect the thermometers from atmospheric influences were then in use. Hence resulted a multitude of errors concerning the true nature of the internal heat of vegetables.

We will cite in the first place Hunter's experiments,† made in 1775, upon a walnut tree, by means of a hole which he had bored in it, in an obliquely downward direction toward the center. He made the following remarks, which are not without interest. The sap of the walnut, which flowed abundantly, was frozen at 0° when it was drawn from the tree, although the temperature of the latter was lower.

Why does the sap, he asked, preserve its fluidity in its natural channels much below zero? He cites the property possessed by water of freezing more easily when in a considerable mass, than when it is found in capillary spaces, where the attraction exerted by the sides upon the liquid molecules opposes their solidification. Indeed, Senebier has seen

* Géographie Botanique raisonnée. Paris, 1855, vol. 1, p. 36.

† Philosophical Transactions, 1775, vol. lxv, Part II, pp. 446–458; 1778, Part I, vol. lxviii, pp. 7–49; Journal de Physique, vol. ix, vol. xvii.

water remain liquid at 7° below zero in capillary tubes, with a diameter greater than that of the ducts of plants.

Neuffer* and Schübler† have found that trees freeze with more difficulty, as their layers are closer. This circumstance contributes to give vegetables the power of resisting a high degree of cold. Rumford and Leslie have also made the observation that air being a bad conductor of heat when its molecules cannot be displaced, must be the best envelope we can take to oppose refrigeration. It seems to result from this that the more layers possessed by vegetables the better ought they to resist cold. Such is the case with plants having a large number of epiderms, as the birch, which attains the highest elevation in the Alps, and advances farthest into the polar regions, and as the horse-chestnut tree, which flourishes in the tropical regions.

Observations were also made at New York in 1783 by Schœpff‡ upon the temperature of vegetables, but without a properly arranged plan. Nevertheless, these observations show that when the temperature was raised or lowered in the air, it was equally raised or lowered in the tree, which of course indicates that both are subject to the same caloric influences. When we compare two trunks which have not the same diameter or merely two branches, we see that if they have been exposed to the same temperature, the thicker cools less quickly than the other.

Numerous observations have been made according to a more exact method by Pictet and Maurice§ at Geneva, from 1796 to 1800, upon a horse-chestnut tree, in the trunk of which a hole had been bored on the north face to receive a thermometer. The results were as follows: During the five years from 1796 to 1800 the annual mean temperature of the air on the north side was sensibly equal to that of the tree. The annual difference between the two means being only 0.04 of a degree, we may infer that the mean temperature of the tree was strictly equal to that of the air. The difference between the monthly temperatures of the air and those of the tree was more or less sensible according to the season. During the winter months the temperature of the earth at $1^{m}.29$ (a little over four feet) below the surface of the ground is higher than that of the tree; in spring, it is the reverse. In summer, according to the year, the temperature of the earth is higher or lower than that of the tree; and in autumn it is always higher. In general, it is toward autumn the temperatures are nearly equalized.

De Candolle, and other physiologists, believe that these effects are solely due to the water sucked up by the roots, descending to this depth, and possessing in winter a higher temperature than the air. Becquerel observes that the influence of the temperature of the water sucked up by the roots cannot be questioned if the sap is in motion; but that there must still be taken into consideration the heat liberated in the chemical reaction occurring in the tissues, and that of rain-water according as it falls more abundantly in one season than another. If this water falls in summer, it tends to warm the ground; if in winter, it, on the contrary, tends to cool it. However this may be, the principal cause of vegetable heat lies almost entirely in the atmosphere, which tends to establish an equilibrium of temperature between itself and all bodies immersed in it.

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* On the temperature of vegetables, book in 8vo. published at Tübingen, in 1829; Bulletin des Sciences Naturelles et de Géologie, vol. xx, p. 260.

†Poggendorff, Annalen der Chemie, 1827, vol. lxxxvi, p. 581.

‡Naturforscher. Halle, 1783, 23 sti., pp. 1–37.

§ Bibliothèque Universelle de Genève. Bibliothèque Britannique, Agriculture. vol. i–v.

Although the mean temperature may be the same in the air and in the tree, nevertheless, the variations that are met in the tree are much less than those in the air; the tree, therefore, preserves longer its acquired heat within limits depending upon its diameter.

Another important fact shown by the Geneva observations is that the maximum of temperature in the air, according to the season, takes place from two to three o'clock p. m., while in the tree the temperature continues to rise, however feebly, from two o'clock until sunset, when the observations were ended. Thus the maximum in the tree appears later than in the air. Moreover we need only take the mean of the tree's temperature at sunrise and sunset in order to obtain almost exactly the mean temperature at two o'clock. During the three years, 1796, 1797, 1798, the variation of temperature through the night, in the air, was at a mean of 3.42, and in the tree of 0.73; that is to say, 4.69 times greater in the first case than in the second.

In 1826, Halder* advanced the assertion that trees are sometimes found in winter at a temperature below the freezing point, and pass even to a congealed state without injury to their vitality. The thermometer had descended almost to -15° and $-17^{\circ}.7$ in some young trees without hindering their vegetation. Halder attributes to evaporation the lower degree of temperature observed in the tree.

Rameaux† has reached the following conclusions: 1. The temperature at any altitude at the center of the trunk of a poplar tree increases during the day and diminishes during the night; always differing in one section from another, according to the thickness. 2. Before sunrise, and even for some time afterward, the central temperature decreases from the foot of a tree to its top. The contrary takes place during the rest of the day. 3. In the daytime, the temperature of a section is carried as far beyond the temperature of inferior sections as the ambient heat is stronger. These differences reach their maximum about sunset, after which they diminish gradually, are effaced little by little, and end by taking contrary signs. 4. During the night the temperature of any section was so much higher than that of the sections situated over it as this was lower than the ambient temperature. The differences reached their maximum toward sunrise, after which they diminished very rapidly, ending by taking contrary signs. 5. In the morning, before sunrise, the central temperature of the tree in its four sections was inferior to that of the ground at the mean depth of its roots; during the day it was the contrary. Rameaux finally reached the following conclusion: Atmospheric heat, if not the sole source, is so predominant a cause of vegetable temperature that its effects weigh down all the other causes put together. Whence it follows that the temperature of a tree must, in each section, increase from surface to center during the daytime, when the ambient heat is highest; it must diminish, on the contrary, from center to surface during the night. The author, nevertheless, believes that the temperature of the ascending sap must exert some influence equally with that of the air.

In the polar regions we observe the same facts. The experiments made by Bravais,‡ at Bossekop, and by Thomas, at Kaafiord, in the winter of 1839–'40, have proved that heat follows in the interior of pine trunks the curve of the temperatures of the air, with a retardation of eight to twelve hours. When the diameter of the tree was increased

* Thèse sur la Température des Vegetaux. 1826.

† Annales des Sciences Naturelles, seconde série, vol. xix, p. 1. Botanique.

‡ Voyage en Scandinavie, en Laponie, &c., Paris, 1848, (Géographie et Botanique.) tome 11, p. 217.

the retardation was greater. We can conclude from all these experiments, adds Becquerel, that cold penetrates to the heart of living trees, as to that of dead ones; that in the living pine the temperature throughout the greatest cold is a little more elevated, either because the sap sometimes rises even through mean temperatures of the air inferior to zero and heats the interior of the tree by becoming congealed, or because the heat of the ground being superior to that of the air, gives the sap a portion of its proper heat, as is the case in the north of Europe. This is, however, only a supposition.

According to Becquerel, the observations hitherto collected upon the temperatures of vegetables, lead to the following consequences:

1. The annual mean temperature of vegetables is the same as that of the air; the two curves of temperature have the same appearance although not coincident throughout, considering that trees only participate in the diurnal variations of the temperature of the air in proportion to their diameters. The air is, therefore, the principal source of vegetable heat.

2. The maximum of temperature in the air is reached in winter about two o'clock in the afternoon, and in summer about three o'clock; in vegetables these hours are delayed according to their bulk. In trees with a diameter of three or four décimètres (twelve to fifteen inches) the maximum occurs in winter about nine o'clock p. m., and in summer about midnight.

3. When the temperature of the air sinks below zero, vegetables resist for a longer or shorter time this cooling, as well as the heating which follows a thaw, without being due to the bad conducting properties of the wood. When the cold continues during many months, as in the north of Europe, the temperature in the tree is successively lowered, but never as far as in the air. There is a difference of from one-half to a degree.

4. The temperature of vegetables, which is almost wholly derived from without, appears, nevertheless, to be influenced by the heat liberated in chemical reactions in the tissues, and by the temperature of the soil from which their roots extract liquids to form the sap. We are still ignorant how, in winter, when the upward motion of the sap is almost suspended, the underground temperature may diminish refrigeration, although the external temperature is below zero.

5. Trees exposed to solar and to nocturnal radiation, during the day and a great part of the night, heat the strata of air with which they are in contact, and cool them when the leaves have taken the temperature of the air before the sun has yet appeared. But its cooling effect is small under the latitude of Paris, at least during the spring, at which time the observations were made. Woods and forests probably exert the same influence, varied by divers causes; but they really act as repositories of heat when the trees receive the direct rays of the sun, which is principally from May to October.*

ACTION OF SOLAR RADIATION UPON VEGETABLES.

The air, as a transparent body, only stops a small part of the solar rays in their passage through it. These rays then proceed to opaque bodies, the earth, and to plants, which absorb a much more considerable part of them. Solar heat is therefore one of the principal elements which distinguish agricultural climates as they receive it more or less abundantly, either by reason of latitude or altitude of the localities, of

* Mémoires de l'Académie de Paris. 1860, vol. xxxii, p. 266.

their exposure, of the topographical character of the soil, and of a multitude of atmospheric agents which reflect or intercept the solar rays. As an effect purely local, science at first neglected it; but the savants were not slow in perceiving the enormous influence of this solar heat upon the progress of vegetation, maturity of fruits, &c. Humboldt* did not cease to remind us that solar effects must be studied in order to account for vegetable phenomena, and the Academy of Sciences of Paris has made it a subject of its recommendations to travelers.

In practice, when desiring to plant a vine, horticulturists choose a southerly and inclined position; they place the fruit grove at the foot of a wall which receives and reflects the rays of the sun; they cover plants which require much heat with glass, which receives luminous heat, and emits more slowly obscure heat, thus accumulating caloric under its shelter. "All these things occur in ordinary practice," says Gasparin, "while those who do them are not able to give any account of the effects either of light or heat." "When we see," he adds, "within the limits of vegetation, the olive unproductive at Agen with 14° of mean temperature, and fertile in Dalmatia with 13°; the limit of vines arrested at 12° on the banks of the Loire, and reaching 10° on those of the Rhine; harvest-time happening at London with a summer temperature of 17°, at the very same time that it does at Upsal with only 15°, we are obliged to recognize that these phenomena depend upon the presence or absence of an important element of calorification, luminous heat, which raises the temperature of opaque bodies above what they could receive from the diffused heat of the atmosphere."†

In 1840 Gasparin made some experiments upon three mulberry trees of the same variety, the first receiving full solar rays, the second receiving them only till noon, and the third kept entirely in the shade. The solid matter of the leaves of the first had a weight equal to 0.45 of the whole leaf, that of the second 0.36, and that of the third 0.27.‡

In 1852 he cultivated beans on a plat of ground divided by a partition which shaded one-half of it from the solar rays. After drying, the plants from the south weighed $0^{k}.581$; the same number of plants grown at the north, although much more developed in height, $0^{k}.337$; but it was especially in their fructification that the difference was remarkable; the southern plants had one hundred and thirty-one pods, the northern only forty-seven.

"It is impossible," adds Gasparin, "to attribute these results to a simple augmentation of heat; light enters into it for the most part, combining its influence with that of caloric. Indeed, in this experiment the plants had received in eighty-four days a sum of 1,286°.59 of atmospheric heat and only 255°.71 of solar radiation. Certainly an addition of 3°.07 of obscure heat received each day in a greenhouse could not have produced such results."

The incontestable effects of radiation upon vegetation struck De Saussure, the great observer of the Alps, and he sought to estimate it by means of experiments upon heat condensed at the bottom of a glass box. Pouillet has estimated the quantity of solar heat which reaches the limit of the atmosphere at 1°.7633 per minute. By supposing the sun at the zenith, he has found for Paris the mean 0.7390 as the number of rays which reach the earth. Forbes has found in Switzerland 0.680, and Quetelet, at Brussels, 0.615.

* De Distributione Geographica Plantarum, &c. Paris, 1817, p. 163; Asie Centrale, &c. Paris, 1843, vol. iii, pp. 34, 157.
† Comptes-Rendus de l'Académie des Sciences de Paris, 1853, vol. xxxvi, p. 974.
‡ Comptes-Rendus de l'Académie des Sciences de Paris, 1840, vol. x, p. 434.

But what is especially important to know, for agricultural practice, is the quantity of solar heat which strikes opaque bodies and accumulates there, by the great principle of conservation of forces, together with the variable state of the temperature of these bodies exposed to the sun, on different days of the year and different hours of the day. When we see solar radiation produce effects so diverse in opaque bodies according to their nature, volume, figure, color, &c., we see how difficult it is to know what happens in each structure of the vegetable kingdom. Thus wheat struck by the sun acquires a temperature different from that of grapes or melons; the leaves, a temperature other than the stem, flowers and fruits; the parts dry or deprived of life become warm very differently from living bodies, whose surface constantly transpires, and whose heat never much surpasses that of the surrounding air.

Another mathematical and astronomical question which must be taken into consideration, is: that the sun strikes the earth's surface more or less obliquely, and acts upon it according to the sines of the angle of incidence, and, while ovoid bodies are fully affected by these changes of inclinations, spherical bodies are not at all. We, therefore, perceive what importance this capital question has in regard to the amount of solar radiation received by the soil, by leaves or fruits, according to their extent and form, relatively to the law of the sines of the angle of incidence.

From many observations upon solar radiation made in France, at Brussels, in Switzerland, and in Russia, Gasparin draws the following conclusions: That the mean radiation augments in advancing from west to east in the old world; it then becomes feeble at the west of America; it also augments considerably with the altitude. The solar radiation being in an inverse proportion to the amount of diffused vapor held in solution by the atmosphere, and this vapor being more abundant near the great reservoirs of water in the direction of the prevailing winds, it must increase in the direction from west to east. The quantity of vapor is also as much smaller as the stratum of air becomes rarer with increase of altitude. The length of the day or of the seasons has considerable influence on the effects of radiation; thus, for equal radiations:

In winter, radiation acting at Lougan as 100, it acted at Bogoslow as............	74
In spring, radiation acting at Lougan as 100, it acted at Bogoslow as............	108
In summer, radiation acting at Lougan as 100, it acted at Bogoslow as............	118
In autumn, radiation acting at Lougan as 100, it acted at Bogoslow as............	92

The greater amount of radiation in summer is explained by the excessive solar heat of the interior climates of continents, where an insolation, for instance, from 29° to 30° is not in relation to the obliquity of the ray incident at the earth, which does not become heated in the same proportions as isolated opaque bodies. The strongest radiations take place when the sun pierces *cumuli*, the ground of the sky being blue. It seems, then, that the vapors are attracted and clustered to form masses of clouds, leaving the intermediate spaces free from vapors.*

From the time of Reaumur down to our own days, it is temperatures observed in the shade that agriculturists have pretended to apply in seeking the heat proper for vegetables. But plants being more or less exposed to the sun, this estimate is evidently faulty, in the case of crops, for instance, in which the heat might very notably differ from that of a thermometer submitted to solar radiation. Thermometric observations made in the shade must, therefore, be ill-applied to the phenomena of

* Annuaire de la Société Météorologique de France, 1855, vol. iii, pp. 230–445.

vegetation. This objection appeared very strong to Gasparin,* who recalls the fact that Humboldt already insisted upon the necessity of measuring the calorific effect of the solar rays upon plants and upon the soils where they grow. From two series of observations made by Gasparin, at Paris and at Orange, which he has compared with another series carried out on Mount Peissenberg, in Bavaria, situated at 975 metres above the level of the sea, he concludes that, in addition to the atmospheric temperature plants receive in the three climates, at Paris, a supplement of 5°.0 of solar heat; at Orange, 11°.15, and at Peissenberg, 7°.12. This excess takes place at two o'clock in the afternoon; and Gasparin believes that it will be probably one or two degrees more at noon. But to judge of the real effect upon vegetation we must, after calculating the mean temperature of the day, add to it that of solar heat.

Exact observations, like Gasparin's, but with index thermometers, have been made in the gardens of the "Horticultural Society of London," at Chiswick, from 1826 to 1840. Three thermometers were observed. The first, covered with black wool and exposed to the sun, gave the maximum of insolation; the second, also covered with black wool and exposed to nocturnal radiation, showed the minimum; finally, the third was placed in ordinary conditions in the shade. The mean of the first two thermometers gave the mean temperature between the extremes produced by insolation and radiation, that is to say, according to Dove, the mean of a locality successively exposed to the sun and to radiation. This mean is not like that taken by the ordinary process in the shade; the relation is 12°.2 to 9°.96. It differs besides from month to month. This series of observations is probably the only unexceptionable one.

De Candolle makes the following remark: "However this may be, it is a much more important thing to know if vegetables are affected by insolation and radiation, in a similar manner as a copper ball, as the bulb of an ordinary thermometer, or one filled with water, mercury, or alcohol, and covered with a poor conducting black substance, &c. To what point, and by what process, can the impulsion given to the vegetable machine by solar rays be compared to the changes of a thermometer? All the authors have understood that the varied coloration of plants did not permit of comparing them from any point of view with a black-bulb thermometer. The effects of insolation and of radiation are evidently less intense or less extreme. Gasparin found more analogy with a thermometer covered with a millimetre of earth, and Dove with a thermometer unblackened, 'that sensibly reduces solar action,' adds De Candolle, 'but many other causes act in the same way, which physicists find great difficulty in indicating. An almost solid body, such as a leaf or a branch, cannot become heated in the same way as a liquid contained in a ball, especially when that solid body is a bad conductor, and the liquid with which we compare it is at once mobile and a good conductor. Vegetable tissue is cooled during the day by the continual ascent of the sap and by evaporation; during the night these causes of modification almost completely cease, and radiation produces its whole effect. The transport of sap toward the leaves causes, under the influence of light, a considerable evaporation, which diminishes the caloric effect of the sun. The stems, and sometimes the leaves, are vertical; and in general the parts of a plant are not presented at the angle which produces the greatest amount of warmth and of radiation. Moreover,

* Cours d'Agriculture. Paris, 1844, vol. ii, p. 72. A second edition of this volume appeared in 1852. The chapter upon solar action (p. 77) is more developed.

they are reciprocally shaded. When an isolated tree is bushy, or in a forest, little more than a tenth or twentieth part of its surface, perhaps, receives solar action and radiates freely. The more a plant is heated and its activity urged by the calorific and chemical rays of the sun, the more it evaporates, diminishing thereby the temperature of the green parts."

On the whole, De Candolle concludes that for isolated trees the distributed heat differs little at the north and at the south, or rather that it does not produce the same effects upon the vegetable machine as upon thermometers. No thermometer can be compared exactly to the tissue of plants from a purely physical point. Vegetables at times experience chemical influences from rays which do not act at all upon thermometers. Luminous rays also act very differently: in the thermometer they expand a liquid, and in the plant they work a very complex machine. The best way of establishing the direct effect of the sun and of radiation upon vegetables cannot be by observing thermometers, but by seeing how vegetables of the same species act when placed in the same soil—some in the sun, others in the shade.

Such are the scientific considerations which must be taken into account in order that the effects of solar radiation may definitely enter into the study of the vital phenomena of vegetation.

ACTION OF NOCTURNAL COOLING AND DIURNAL HEATING OF CULTIVATED SOILS.

Cooling of the superficial layer of ground during the night.—In cold countries, where the earth is covered in winter with a coat of snow more or less thick, under this protecting mantle the roots of vegetables and the seeds which have been sown in autumn escape the variations of atmospheric heat. Temperatures inferior to that of melting ice penetrate slowly through the bed of snow, while temperatures above zero stop at its surface. The latter then pass to the state of latent heat, and melt snow to a depth according to the rise of the temperature above zero, to the agitation and to the humidity of the air.

It results from this that the temperature of the superficial layer of the ground approaches very nearly to the atmospheric mean, and the ground freezes more or less hard and deep, as the mean of winter is more or less below zero.

In countries with mean temperatures, where the ground is sometimes bare, sometimes covered with snow, we cannot indicate in a general way how it is influenced by the air. Under a climate in which snow is comparatively rare it is important to study the relations between the temperature of the soil and that of the air in contact with it during cold weather.

Judging from the numerous observations of Charles Martins, the city of Montpellier, in fertile Mediterranean France, seems to offer us an excellent means of comparison. In winter, by a *maestral* from north-northwest, the sky is kept perfectly clear, and the air, heated by the sun, is very agreeable during the day. At night, the purity of the atmosphere favors terrestrial radiation, and the thermometer in the open air often descends to -12° C., but during the following day it attains in the shade 15° above zero. While the aerial parts of plants are exposed to these great variations, which are sensible at the heart of the stalks and trunks, what takes place with the subterranean parts, and with seeds buried in the ground? Such is the question Charles Martins proposed to solve by studying the nocturnal cooling suffered by the different

kinds of earth employed in horticulture. The following is the mean value, observed near the surface:

Willow tree mold	1°.60	Heath mold	1°.32
Red clay ground	1°.46	Common mold	1°.25
White calcareous sand	1°.43	Yellow sand	1°.22
Leaf mold	1°.40	Garden mold	0°.60

Mean 1°.29.

We see that soils cool unequally, and that between willow tree mold and garden soil, the difference amounts to just *a degree.* This result deserves to be taken into consideration, for a degree of difference is the life or death of a seed. Seeds buried deeper in the ground are more protected against cold. Here is a table of mean minimum temperatures observed during the night, at a depth of $0^m.05$:

	Surface.	*At* $0^m.05$.	*Difference.*
Willow tree mold	—2°.8	0°.8	3°.6
Yellow sand	—1°.8	0°.8	2°.6
Heath mold	—2°.5	0°.8	5°.1
Garden mold	0°.7	2°.2	1°.5
Mold	3°.2	4°.6	1°.4
Red clay	2°.2	5°.2	3°.0
Mean	0°.13	2°.40	2°.53

We see that nocturnal cold does not penetrate into the different kinds of soil with equal rapidity. Willow tree mold, for instance, which becomes the coldest at the surface, according to the previous table, is the one which nocturnal cold penetrates most slowly, since the difference between the temperature of the superficial layer and that at $0.^m05$ is greater than in any of the other kinds of soil. We know that willow tree mold is composed of fragments of decayed wood, between which air is interposed; both wood and air are poor conductors of heat; hence probably the small amount of cooling in this mold. Heath mold is in the same condition. We are not so well able to explain, adds Martins, why red clay ground is a bad conductor of heat, and why garden soil and heath mold are good conductors. But by comparing these two tables we can say generally that nocturnal cold penetrates less quickly soils which cool most rapidly at the surface, and *vice versa.* It is evident that this arrangement is favorable to the preservation of seeds and of roots buried in the ground.

The layer between the surface and the depth of $0^m.05$, in which we have examined the influence of nocturnal cold, is that where lie the seeds and roots of annual plants; but long-lived vegetables, shrubs, and especially trees, bury their roots to a much greater depth. During five consecutive winters, from 1858 to 1862, Martins has followed the temperature at the "Jardin des Plants" of Montpellier to the depth of $0^m.10$ and of $0^m.30$. As a mean, the minimum at the smallest depth ($0^m.10$) was always superior by 7°.2 to the temperature of the air observed at $1^m.50$ above the ground. Martins concludes that on reaching a depth of $0.^m30$ the roots of plants which pass the winter in the open air at Montpellier always find a temperature above zero. Further on, in the chapter on frost, will be found other conclusions upon the cooling of vegetable mold.

Heating of the superficial layer of ground during the day.—Martins has also studied the mean relative heating properties of the different kinds of soil near the surface, between 11 o'clock in the morning, when the ground becomes sensibly warm, and 3 o'clock in the afternoon, after which

the warmth in winter does not increase. Here are the means of these indications observed near the surface of the ground:

Red clay ground	17°.87	Willow tree mold	16°.87
Garden mold	17°.57	Leaf mold	16°.26
Heath mold	17°.08	White sand	16°.16
Common mold	15°.92	Yellow sand	16°.04

Mean 16°.85.

Martins concludes that this order is not that of the cooling in the first table, and that their comparison shows that the emissive and absorbent powers of soils are not the sole elements which determine their cooling as well as their heating. The conducting power of soils for heat, their hygroscopicity, and the greater or less evaporation which is its consequence, complicate the results, as they do not admit of previous estimation. However, he observes that red clay ground is the one which becomes both the most cooled and the most heated at the surface; that of the "Jardin" of Montpellier cools the least and heats the most. Yellow sand presents the most feeble variation of temperature, and willow tree mold, which cools greatly, becomes but moderately heated. The difference between the two extremes reaches 1°.02 for the warmth; it was a degree for the coldness.

During the night the mean minimum of the air at $1^{m}.50$ above the ground was 1°.31 above the mean minimum—1°.29 of the observed soils. The mean temperature of the heated ground differs very little from that of the air; both observations being made at the same time the former was 16°.85 and the latter 16°.66. Thus, when it becomes cold, the surface of the ground, by its radiation proper, falls below the temperature of the air; but when the ground is warm it heats at the same time the air by reflecting a part of the solar rays. Likewise in the observations of Martins it is sometimes the earth that is a little warmer than the air, sometimes the reverse, and on an average the effects are equal.

The minimum nightly temperature of the air and the surface of the ground agree a little before sunrise; but after the earth becomes warm, its heat increases in general until the afternoon. At the same time, the nightly cold of the surface penetrates the soil with a rapidity which can be estimated at about a decimeter every three hours.* It requires according to Martins, an hour and a half to reach a depth of $0^{m}.05$. Hence it results that before the middle of the day the heat is weaker at $0^{m}.05$ than at the surface. Thus, while the cold radiation penetrates the ground, it is incessantly heated on the surface by the action of the solar rays. But the difference is never great, for the effect of this cold radiation is weakened as it penetrates the soil by the calorific radiation stored up in its breast during preceding days. In eighty observations Martins has found only three in which the temperature was more elevated at $0^{m}.05$ than at the surface. In all the rest the ground between 11 o'clock in the morning and 3 o'clock in the afternoon was hotter at the surface than at that depth.

The following table, according to Martins, gives the difference of temperature for six kinds of soil; the figures express the degrees of warmth at the surface above that $0^{m}.05$ of depth.

Red clay ground	2°.28	Garden mold	4°.82
Common mold	3°.78	Heath mold	5°.78
Yellow sand	3°.93	Willow tree mold	5°.80

Mean 4°.40.

Red clay, a good conductor of solar heat, is that in which the differ-

* Quetelet, Climat de la Belgique. Tome 1, p. 153.

ence of temperature between the surface and the depth of $0^m.05$ is least. Willowtree mold and heath mold, both bad conductors, are those in which the difference is greatest. The other three range between these extremes.

From this estimate of the physical properties of these different soils of nocturnal cooling and diurnal heating near the surface, and a depth of of $0^m.05$, Martins concludes that red-clay ground is that whose surface cools and heats the most. The nightly cold of radiation is not diffused well or deeply in this species of soil; the solar heat, on the contrary, penetrates it easily, as is proved by the smallness of the excess ($2^\circ.28$) at the surface of the soil over the temperature at $0^m.05$ of depth. It is precisely this soil which covers the hills in the environs of Montpellier which are planted with vines and olives. We conceive that this double property is favorable to vegetables, whose roots penetrate deeply into the soil and are little affected by the variations of the surface. Thus, on these hills there is no instance of olives dying out; the layer is never bare and the tree always shoots again from the stump.

Martins deduces the following horticultural consequences.

If we consider the different varieties of soil studied in this memoir in regard to seed-beds, we will conclude that heath mold is the most proper ground for obtaining prompt and sure germination; because on the surface it does not cool much and nocturnal cold penetrates it slowly. On the other hand, it becomes highly warmed under the influence of the solar rays, and this heat remains at its surface and penetrates slowly, a circumstance equally favorable, as the heat is concentrated around the seed sown near the surface. Common mold has the advantage of not cooling much on the surface, but nocturnal cold penetrates it rapidly. It is true that this mold becomes highly warmed during the day, and that the heat penetrates it easily. Seeds are, therefore, exposed to large alternations of temperature. These alternations are still stronger in red-clay ground, which cools considerably during the night, and becomes highly warmed during the day: but, unfortunately, solar heat is propagated in it much better than nocturnal cold. The sands cool and heat little on the surface; cold and heat are not more diffused. Thus the temperatures of the soil play as great a part as that of the air in the difference which is observed between the horticulture of Mediterranean France and the north of Europe."*

THE NOCTURNAL INCREASE OF TEMPERATURE, WITH HEIGHT IN THE INFERIOR STRATA OF THE ATMOSPHERE, AND ITS ACTION UPON VEGETABLES.

Farmers have remarked for a long time that after cold nights in spring tender vegetables, like the vine, the olive, and peach trees, suffer from the frost in the valleys and low positions, while on the hills the injury is less or nothing. These disastrous effects are attributed, by popular prejudice in Europe, to the malign influence of the *April moon*. Each winter we see, after one or more cold nights, exotic plants die in the lower parts of a garden, while others of the same age and of like vigor survive them in more elevated stations. We expect to prove here that these differences are explained naturally by a constant increase of temperature with the altitude during calm nights in the stratum of the atmosphere next the ground.

This intervention of temperatures was observed as far back as 1778, by Marc Auguste Pictet,† at Geneva, and confirmed by Six‡ at Canterbury in 1784, by Marcet§ at Geneva in 1837, by Bravais and Lattin‖ at

* Du Refroidissement nocturne et de l'échauffement diurne pendant l'hiver de Montpellier, des diverses especes des terres cultivées. Mémoires de l'Académie des Sciences de Montpellier, 1863, vol. v, p. 367.

† Versuche über das Feuer. Tübingen, 1790. 8°. p. 170.

‡ Philosophical Transactions, vol. lxxviii, p. 103.

§ Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, 1838, vol. viii.

‖ Voyages en Scandinavie at au Spitzberg, &c., Météorologie, vol. iii, p. 94.

Bossekop in Lapland in 1838–'39, by Plantamour* at Geneva in 1847, and by other observers. Lastly, Charles Martins† has reached the following conclusions: During the night the increase of temperature from the ground up to fifty meters (about one hundred and sixty-four feet) is an almost constant phenomenon, for out of ninety-eight nights he found only 9 in which he had a decrease of temperature between 0m.05 and 49m.4; the increase is therefore the rule, the decrease the exception. The mean annual increase, or the mean difference between the minimum at 0m.05 and that at 49m.4, by taking the ninety-seven nights in which the temperature of external points was noted, reached 3°.80. This increase, supposing it uniform, will, therefore, be 1° for every 13 metres; it does not appear to vary much from one season to another. The phenomenon is wholly independent of the thermometric cold and heat in which the mercurial column oscillates. This increase is not uniform; very rapid in the vicinity of the ground, it diminishes as we ascend into the atmosphere. The increase of temperature with the altitude is principally due to terrestrial radiation, and consequently depends upon the clearness of the sky, for it is nearly five times greater on clear nights than on cloudy ones. It is very evident that the increase is greater, not because the superior strata become heated, but rather because the inferior strata are cooled by contact with the soil.

If now we seek the influence of the wind, Pictet, Marcet, Bravais, and Martins are unanimous in declaring that calmness in the air is one of the most favorable conditions to increase of temperature with the altitude. Martins finds that it is always the same for the air upon natural roughnesses of the soil in plains, upon hill tops, or upon towers and other edifices. He has also found that this increase commences an hour before sunset in calm weather, and even at its setting with a clouded sky, remaining stationary until morning, when the weather does not vary, and the dew is not very abundant. This result is important, inasmuch as it shows that the difference indicated by the minima are not of short duration, but permanent during the whole night. His observations, moreover, show that this increase extends to a height of fifty metres on all clear nights, and even on the generality of cloudy ones. So the increase of temperature with the altitude, during the night, is a constant fact in France, England, Switzerland, and as far as the 70° of north latitude, wherever it has been studied.

Martins thus accounts for the daily decrease and the nightly increase of temperature in the inferior strata of the atmosphere. During the day the solar rays, traversing the atmosphere, raise its temperature very little, for one-third, at least, is absorbed in its depth;‡ the other two-thirds reach the ground, which they greatly warm, and it is the ground in its turn which heats from below the divers layers of the inferior stratum of air. This cause, pointing to others which Martins has exposed in detail,§ produces the daily decrease of temperature with the altitude. But after the sun begins to approach the horizon, its oblique rays traversing an atmospheric stratum constantly deepening, heat no more either the air or ground. Both, especially if the sky is clear, commence to radiate toward space, and consequently to grow colder. The ground radiating more densely, cools the stratum of air in contact with

* Bibliothèque Universelle de Genève, 1848, vol. vii, p. 22.

† Mémoires de l'Académie des Sciences de Montpellier, 1861, vol. v, p. 47.

‡ Quetelet, Bulletins de l'Académie des Sciences de Belgique, 1861, vol. xi.

§ Des Causes Physiques du Froid sur les hautes montagnes. Memoire de l'Académie des Sciences de Montpellier, vol. iv, p. 278. Annales de Chimie et de Physique, 1860, vol. viii.

it; both these effects continue all night, and until the solar rays come to warm anew the surface. The longer the night and the clearer the sky, the lower is the temperature of the ground, and, consequently, that of the air which bathes it. The air, in general, will be colder, as the earth's surface is colder, because it radiates of itself, and these effects of radiation are added to the cold communicated by the surface of the ground. On the other hand, the surface of the ground itself is generally warmer than the air in contact with it, as the losses it suffers by radiation are in part repaired by a flow of heat from the interior to the exterior. This interior heat of the ground proceeds from the diurnal warmth, as is established above. The refrigeration of the bases of atmospheric columns is propagated to a point more or less high, where the proper temperature of the air is equal to that of the stratum in contact with the ground. The clearness of the sky, the direction and temperature of the wind, the outline of the country, the presence or absence of lakes or great rivers, the vicinity of the sea, all influence this complex phenomenon to which I call the attention of meteorologists and farmers.

Applications to agriculture and horticulture.—The inconvenience of depressions of the soil, and the advantage of high lands, says Martins, were long ago pointed out without the true cause being known; effects of which cold was the cause, and humidity the consequence, were laid exclusively to the account of the latter. Thus, the slower ripening of cereals, the invasion of ergot and of other cryptogams, was solely attributed to water in a liquid state in the ground, or in a vaporous state in the air. We now know the part played by temperature, and it explains to us facts before inexplicable. Thus we have seen, after cold nights, in the south of France, olive trees frozen to a certain altitude on the hills, and preserved beyond this limit. Some meters of difference in level are sufficient to decide whether a tree shall perish or be saved. Martins relates that on January 21, 1855, when the temperature descended in the lower part of the botanic garden at Montpellier to —18°, almost all the laurels around his residence perished, while others in exactly the same conditions as to shelter were saved at positions a few meters higher.* It was the same with the fig, olive, and other exotic trees or shrubs.

Milne Home † has remarked that the lowest localities are those where the greatest colds have been observed. Thus, in the environs of Edinburgh the two low stations of Smeaton and East Linton were those where the most intense cold was felt in the winter of 1860–'61; in England this happened at Nottingham, which is situated in a hollow, and far from the sea.

Moreover, when young vine buds are killed by spring frosts, it is always, so to say, proportionally to the height; it is a rare accident that a cause of warmth comes to counterbalance that of the cold. Whenever the decrease of temperature is considerable enough near the ground, the leaves or branches of tender shrubs in contact with it are found reddened, while those higher up are safe. In the south of France mulberries have been killed by frost on a low stem, while those on a more elevated trunk, growing on the same soil, were saved. Paran, engineer of the mines at Alais, established this fact upon a large scale in the spring of 1860.

As to large trees, Martins affirms that when they exceed six meters in height, during clear nights there is a mean difference of 1°.76 be-

* Mémoires de l'Académie des Sciences de Montpellier. 1855–'57. Vol. iii, pp. 91–106. Revue Horticole. 4e série. Vol. iv, p. 288.

† Balfour, Transactions of the Botanical Society. Edinburgh, 1863. Vol. vii, p. 58.

tween the temperature of the air at the base of the trunk and that of the stratum surrounding the branches at six meters above the surface. This difference may even exceed two degrees. "Why be astonished after this," adds Martins, "at finding on a tree in foliage from its base, leaves frozen near the ground, while others are perfectly green at six meters above? We should also give but limited confidence to the thermometric degrees given by horticulturists as corresponding to the freezing of certain vegetables; for the thermometer consulted is often far from and on a different level from that of the vegetable observed. Should we desire to obtain rigorous results, the thermometer must be placed by the side of those parts of the plant we wish to study, and at the same height."

In résume, here are the conclusions of Martins:

1. On clear nights there is always an increase, with the height, of the temperature of the air in its inferior stratum. At Montpellier the limit of this increase is generally above fifty meters.

2. The increase is not uniform. More rapid near the ground, it has a mean of 1° Centigrade for every thirteen meters, between $0^{m}.05$ and fifty meters.

3. With a cloudy sky the daily decrease continues during the night, or else the nocturnal increase is very slight, namely, a mean of only 1° for forty-six meters.

4. With a clear sky the increase is much more rapid—a mean of 1° for nine meters.

5. The thermic excess is the same at the top of a hill as on that of a tower with the same altitude.

6. A strong wind tends to equalize the temperature in the inferior atmospheric stratum, in which the nocturnal increase is apparent.

7. The Montpellier results being sensibly in accord with those of Pictet and Marcet at Geneva, Six at Canterbury, Bravais and Lattin at Bossekop, in Lapland, this phenomenon may be considered as general and alike in all latitudes.

8. A thermometer sheltered from zenithal and terrestrial radiation marks as a mean during the night a temperature more elevated by 0°.90 than one which radiates freely in all directions.

9. The temperature of the surface of the ground itself is almost always a little higher than that of the stratum of air immediately in contact with it.

10. Terrestrial radiation is the true cause of the nocturnal increase of temperature with altitude. During the day, the earth being warmed by the sun heats the air by contact in its turn; it cools it at night by radiation into space.

11. Series of meteorological observations are not comparable, if the stations are not similarly situated, and the instruments placed at the same height above the ground.

12. All these facts account for the freezing of vegetables in hollows, and their preservation on eminences, after the cold and clear nights of winter or spring.*

ACTION OF DEW UPON VEGETABLES.

The condensation of atmospheric moisture upon bodies cooled by nightly radiation, which constitutes the deposit of dew, is a phenomenon

* Sur l'Accroissement Nocturne de la température avec la hauteur, dans les couches inférieures de l'atmosphère. Mémoires de l'Académie des Sciences de Montpellier. 1861. Vol. v., p. 47.

as worthy of study from a physical point of view as on account of its utility in vegetation. At all times dew has impressed the minds of the most casual observers, and all have regarded it as destined to furnish plants, by absorption, the means of repairing the losses caused during the day by transpiration. The celebrated Hales, and all succeeding physiologists and agriculturists, have thought that the dew, which wets the leaves, was absorbed by them, and that this water was added to the mass of nourishing liquids in the plant. By delicate experiments, Duchartre* has, on the contrary, proved *that dew does not penetrate into the tissues of leaves.*

There do not appear to have existed, before Duchartre's researches, any continued experiments which could demonstrate that the leaves of living plants absorbed the dew formed upon their surface, save two incidental passages of Hales in his observations on the transpiration of plants.† But as these first experiments were defective, his assertions are valueless. Bonnet,‡ having laid upon water detached leaves which retained their freshness for a time, thought that they had absorbed the water in contact with them.

Many physiologists have refused to admit this explanation, and Moldenhawer § and De Candolle, || among others, have advanced the opinion "that the position of the stomatum upon the water prevents the evaporation of the juices contained in the leaf and preserves its freshness." Meyen ¶ and Treviranus** affirm in the most formal terms that the suppression of transpiration was the sole cause of the facts observed by Bonnet. Duchartre, on the contrary, has established with the aid of the balance that the explanation given by Bonnet was exact, and that detached leaves placed upon water absorb by either of their faces, more rarely by both, a very appreciable quantity of water simply by local imbibition.†† However, having plunged entirely into the water the foliate capitulum of a *Veronica lindleyana*, living and planted in a pot enveloping an exactly tight apparatus, he saw the plant remain there for forty-eight hours in succession without augmenting in weight, while during the day it transpired sensibly. Thus it is now satisfactorily proved that while detached leaves of plants can absorb by imbibition a certain quantity of water, the same leaves of living plants do not absorb the least particle of the liquid which bathes them. Are we, therefore, to be surprised at seeing leaves in full bloom remain covered with dew during a whole night without absorbing a quantity appreciable by delicate balances? The following physiological considerations will dispel what, at the first glance, seems extraordinary in this fact.

In order to understand why dew is not absorbed by the leaves, and why, in the same way, it does not exactly wet them, we must consider the mode in which it is formed upon plants, the nature of the epidermis of leaves, the coating which it presents, and, in fine, the nature of its organs.

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* Annales des Sciences Naturelles, (Botanique,) Paris. 1851. Vol. xv, pp. 109–160. Bulletin de la Société Botanique de France. 1857. Vol. iv, pp. 940–946.

† Statique des Végétaux. Paris, 1779. Pp. 42–44, 50–52.

‡ Recherches sur l'usage des feuilles dans les plantes, etc. Gottingue et Leide, 1754. Contemplation de la Nature. Hambourg, 1782. Vol. i, pp. 305–312.

§ Beiträge. 1818. P. 98–99.

|| Physiologie Végétale. Paris, 1832. Vol. i, p. 61.

¶ Neues System der Pflanzenphysiologie. Vol. ii, p. 112.

** Physiologie der Gewächse. Vol. i, p. 510.

†† Bulletin de la Société Botanique de France. 1856. Vol. iii, pp. 221–223. 1858 Vol. v, p. 110.

1. *Mode of deposition of dew upon plants.*—Air bathes in some way the bodies surrounded by it, and it adheres rather strongly to their surface. When we observe the epidermis of leaves under the microscope we recognize this adhesion of the air. Now, dew being condensed on the surface of the leaves cannot displace this stratum of adherent air. The dew as it is deposited forms a great number of small globular drops, distinct and separate, which do not exactly wet the leaves. These little drops augment in volume with the increase of vapor condensation, and coming soon in contact with each other, they at length form a continuous layer. Under this liquid coating we perceive a lamina of air more or less complete, which is interposed between the deposit of dew and the epidermis in such a way that contact is not direct.

2. *Condition of the epidermal surface.*—The epidermis is usually found in a state which renders it more or less difficult to wet. This state is a consequence of the evaporation taking place every day at its surface, or in other words its transpiration. "The water alone," says Schleiden,* "is evaporated at its surface, and is deposited as a thicker or thinner layer of substances which were in solution in the cellular juice, covering the external surface of the epidermic cells. At the same time these substances under the action of atmospheric oxygen undergo a chemical modification, and are changed in a manner which renders it still more difficult for the passage of liquid. It is thus that wax and resin appear finally on this surface." "Transpiration," adds Duchartre, "being in direct proportion to the intensity of solar light and heat, it follows that the production of the layer of wax, which coats the epidermic cuticle, takes place in the most energetic manner possible on a fine day, and it is then, too, that dew is ordinarily formed in greatest abundance." This circumstance cannot certainly favor the absorption of water as it is deposited. "If greasy matter," observes Garreau,† "is already an obstacle to the absorption of water among plants whose leaves are buried in part in the ground, it becomes henceforth almost certain that those whose leaves float constantly in the air, and exhale, under the influence of summer heat, a large proportion of fatty substance, ought not to be more endosmotic than the preceding."

The existence of this greasy coating on the surface of the epidermis enables us, moreover, to comprehend why the leaves do not absorb the dew deposited upon both their faces.

3. *Anatomical structure of leaves.*—The air found in a more or less considerable quantity between the cells of their parenchyma is a new obstacle to the penetration of water from the exterior to the interior of the organs of leaves, according to their anatomical structure. On the whole, and for the three reasons indicated above, Dutrochet thinks that the non-absorption of dew by the organs which it wets, is a fact of easy explanation.

It is not without importance in this place to destroy a popular belief, which has even passed into some scientific works, on the subject of faded plants recovering their turgescence by the direct action of dew. Seeing that plants wilted by the heat of day, says Duchartre, recover the turgescence of their tissues and their freshness in the night during which they are covered with dew, it is thought that this circumstance points to the absorption of the water which covered their surface. In this connection scientists, as well as the vulgar, have united. Thus Senebier, in common with all physiologists, in speaking of dew-drops, has said:

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* Die Physiologie der Pflanzen und Thiere. P. 118.

† Annales des Sciences Naturelles. 1849. Vol. xiii, p. 325.

"Plants wilted by the heat of a parching sun, recover their freshness during the night when they are covered with these drops."*

Now, in this conclusion, says Dutrochet, there has been attributed altogether to local and direct absorption what was due to the simple moistening of the ground by the condensation of the aqueous vapor of the atmosphere. Duchartre has been able to elucidate the subject by two modes of observation, which seem to put this confusion into full relief,† and according to which it follows that leaves, even in their greatest thirst for water, do not directly introduce into their tissues the dew deposited upon their surface during the night. It is by the moist earth that the absorption of dew is effected.

To sum up, after the very numerous and delicate observations made by Duchartre during five years, his conclusions relative to the action of dew on vegetation are the following: "Plants do not absorb the dew condensed on their surface, and hence ideas of this kind which have prevailed up to our own day are deprived of foundation. Dew does not, therefore, exert any immediate and direct influence upon vegetation. Its action upon vegetables is no less important in a great number of cases, but it takes place and is explained differently from what we had always thought.

The first effect produced by dew upon vegetables is to *suppress* their transpiration almost entirely, which is already much enfeebled by the obscurity and descent of the temperature at night, but which will continue in some measure without the deposit of dew. Dew, therefore, causes the plant to pass from a period of activity during the day to a period of repose during the night. Thanks to this suppression of aqueous waste, however little humidity the roots find in the ground, they obtain enough to repair the losses which the diurnal transpiration of the leaves caused. Occasionally, even in the absence of all absorption by the roots, the apparent state of the plant may be notably modified by reason of a single displacement of the nourishing liquids, which, from the stem and root, proceed into the wilted leaves, and restore to them the fullness of their tissues.

But it is chiefly through the medium of the ground that dew acts upon vegetation. Its action is exerted in two modes; 1. The dew deposited upon the leaves remains there only in an inconsiderable quantity, for above a certain measure, variable with different plants, it commences to fall upon the ground by its own weight, in a sort of local shower. 2. The earth, as a porous and hygroscopic body, then receives the moisture, which is at once sucked up by the plant's roots, in the same way as the moisture in the air. The dew also trickles along the stems, branches, and trunks to the ground. Upon mountains the soil formed of permeable earth is continually humid. Otto Sendtner, who has made observations in Bavaria, asserts that upon these high mountains dew is more abundant than rain.‡ In the forests of warm countries dew-drops continually fall from the trees in the form of a plentiful shower.

For the rest the total quantity of dew deposited upon leaves has been much exaggerated. Duchartre has made the following experiments, which prove how trifling this deposit is: A *Hortensia* bore fourteen large leaves, whose extent was on each face at least a square decimeter, and 28 square decimeters for the whole surface of the limb. The dew which covered this *Hortensia* was in such abundance that it was gathered into pools wherever it found a small cavity. Nevertheless, all this liquid

* Physiologie Végétale. Vol. iii, p. 94.
† Journal de la Société Centrale d'Horticulture. Paris, 1857. Vol. iii, pp. 77-87.
‡ Die Vegetations-Verhältnisse Süd-Bayerns. P. 83.

stratum weighed only 7.2 grams in two nights of observations, and 7 grams on the third; it had, therefore, only 7 cubic centimeters in volume. We see thence that each leaf had for its part one-half cubic centimeter of water spread out upon two square decimeters of surface. This small quantity of liquid, adds Duchartre, which is sufficient to cover entirely both sides of a leaf, so as even to form the deepest layer it can hold, explains very well the shower of dew which the ground receives every time that the condensation of atmospheric humidity is effected energetically.

ACTION OF MISTS UPON VEGETABLES.

Mists must be dense enough and humid enough to deposit a film of water upon plants. The action of mists upon vegetation has been studied by Duchartre* after the same method adopted in the case of dew, and in the condensation of vapor upon vegetation he reached the same conclusions.

Mist condensing on the surface of plants, even like a heavy dew, has never increased their weight by any appreciable quantity. The leaves and different parts of the plant act under mist just as under the deposit of dew. Where the mist has not wet the plants, the transpiration of the leaves has been only weakened, not suppressed, particularly during the day. But the suppression of transpiration was complete, or at least nearly so, when the deposit of mist had clothed these organs with an entire coat of moisture.

These facts establish conclusively, as Duchartre believes, that mists exert upon vegetation only a secondary influence, since they supply plants with nothing, and only diminish, or at most momentarily suppress their waste. Their function becomes much more important in certain localities, particularly in the zone of mean altitude upon inter-tropical mountains, where the epiphyte plants abound, and where prevails, chiefly through this cause, an excessive humidity. In every case it is from the trickling of water to the ground that the action of heavy mists is as advantageous to vegetation as that of dew.

For the action of mists upon vegetation, as for that of dew, we are forced to confine ourselves to the experiments and conclusions of Duchartre; because all that has been said on this subject has either no scientific value or presents no fact of importance. On the other side, after the hygroscopic action just pointed out, mists appear to have no other influence than that of certain electric mists still doubtful and unknown, or those called *dry* mists, because of the atmospheric dryness which accompanies them.

For the study of this question I cannot do better than to recommend to agriculturists Peltiers's important memoir upon the different kinds of mists.† This conscientious observer divides them into simple, negative, and positive mists, according to their electric nature, the last two being subdivided into two others.

Of the influence of electric mists upon plants and animals he acknowledges that we have not sufficient observations to enable us to treat it properly. In those previously made, some contain only the indication of an electric tension without specifying either sign or intensity; others mention only that diseases have followed the presence of mists, without saying whether or not they were electric. He believes that if agricul-

* Annales des Sciences Naturelles. Botanique. Paris, 1861. Vol. xv, pp. 156–160.

† Mémoires couronnés de l'Académie des Sciences de Bruxelles, 1841-42, vol. xv, 2me partie, pp. 1–25.

turists would follow the progress of mists with an electrometer, according to his method, we should, in a few years, know the true cause of certain alterations in vegetables, and perhaps of certain diseases which suddenly afflict men and animals.

Theory causes him to foresee that when a negative cloud descends very near the ground, all the conducting elevations serve as media for neutralizing the electricity. Animals and plants possess conducting liquids, and as they are raised above the level of the soil serve as radiating points between the earth and the mist. Vegetables penetrating the ground as far as moist soil, and being elevated and ramified into points or asperities, are bodies very suitable to fill this office according to their conducting power. We have many examples where in storms trees have served as conductors of discharges from the clouds, and at the same time preserved their stigmas from injury. Vegetables are conductors only by the sap which penetrates them; consequently every electric current may alter their nature by three means: The first that every electric current traversing a solution renders its extremity acid or alkaline, according to the direction; in this way the leaves and flowers may become more acid or more alkaline, according to the positive or negative influence of the mist or cloud. The second alteration is, that electric radiation takes place at their extremities only by carrying off a part of their humidity. The sap is evaporated and transports contrary electricity, which must neutralize that of the mist, as the water in a capsule or cistern evaporates much more rapidly under electric influence. If this be powerful, the current, and consequently the evaporation, will be considerable, and the plant will be dried up. We have seen wonderful examples of this in the Chatenay water-spout,* and also in the *helm wind* when of some duration. In fine, the current may acquire such an intensity by the passage of thunder or the prolonged efflux of electricity that all the sap is vaporized, it shatters the walls which hold it and the wood into fine splinters. This has occurred very often from thunder-bolts, and the Chatenay water-spout alone furnishes us eight hundred and fifty examples.

Many agriculturists have thought that dry mists *rust* wheat, and Duhamel has said that this effect occurred principally when the crop was in full growth,† and not when its tissues were dry. These two observations connected prove that Duhamel's rust is the product of an electric current, since it takes place after dry mists, and when the plant, by its humidity, becomes a conductor. Another observation due to Lemaître, is, that a thick smoke produced by the combustion of moist grass protects the field over which it rises as a conductor of electricity. What has proved an obstacle to these researches, says Peltier, is the abuse made of the observed connection between "the rust" and dry mists, from which some have referred all other diseases of plants to electric mists. Experiment not confirming this abuse of a good observation, these researches were forsaken.

We invite educated agriculturists to revive the subject, and observe if the tallest plants are not more liable to rust after electric mists than low and sheltered ones, and to compare the loss of sap in reddened plants with neighboring green ones.

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* Peltier, Sur la Formation des Trombes. Paris, 1840. P. 151.

† Élements d'Agriculture. Paris, 1779. Livre 3, chp. 3. Mémoires de Tillet. 1773–74. Fagon, Histoire de l'Académie des Sciences. 1710. P. 62. Phillipar, Traité Uranographique. 1837. Turpin, Sur les maladies des plantes.

ACTION OF LIGHT (SOLAR RAYS) ON THE GERMINATION AND GROWTH OF PLANTS.

When a seed is placed in a humid soil, germination, which constitutes the first symptom of vegetable life, soon manifests itself; the radicle appears first, from which the roots branch out later; then, at the other extremity, the plumule rises, swells, and permits the leaves to appear in a rudimentary state. If we follow the germ during this evolution, we find that it transforms the oxygen of the air into carbonic acid by the loss of carbon. Soon the plant bears full-blown leaves; thence the aërial apparatus is constituted for a function diametrically opposed to the apparatus of the radicle. Now the leaves, when illuminated by the sun, far from giving carbon to the atmosphere take it away by decomposing carbonic acid. During the first period of vegetation, the plant, still in its embryonic state, constantly diminishes in weight, owing to the consumption of its carbon by the oxygen of the air; this is true combustion. But from the time of the appearance of the leaves, the plant increases in weight, owing to the assimilation of carbon which it borrows from the carbonic acid of the atmosphere; this is the opposite to combustion, it is the reduction, the revivification of a charred body. But this assimilation only takes place under the action of light. In darkness the leaves lose carbon as do the vegetable embryo and the roots in all circumstances. A plant during its whole existence is, therefore, really submitted to two antagonistic forces, the one tending to abstract, the other to add matter, and the force which is dominant increases or diminishes the weight of the plant. Following the relation existing between these two forces, which is determined by the intensity of light and temperature, a plant will produce oxygen or carbonic acid in very variable proportions, or it may not emit either of these gases. We thus reach the conclusion that vegetable organism, placed in a feebly illuminated medium, will remain in some sort stationary during entire months, as Boussingault had the opportunity of observing.*

If the plant is constantly submitted to two antagonistic forces, losing useful matter by one and gaining by the other, it is of the highest importance that our efforts in agricultural art should be united for its greatest development and largest production. Of all the natural forces, after that of heat, which exert a powerful influence over vegetable existence, the action of light can be least dispensed with. But in solar radiation we must primarily consider three actions very distinct in their effects, which operate at once simultaneously and independently according to surrounding circumstances. These three elements, which are diversely distributed through the whole extent of the solar spectrum, are: 1. The *calorific action*, principally sensible in the least refrangible rays, the red, and beyond it in the obscure portion of this end of the spectrum. 2. The *luminous action*, in the mean rays of the yellow. 3. The *chemical action*, in the most refrangible rays of the blue and violet, as well as beyond in the obscure portion of the opposite end of the spectrum. It may be remarked that the *red*, *yellow* and *blue*, which have the maxima of the calorific, luminous, and chemical actions, constitute also the three primitive colors which give rise by their mutual combination to the seven colors of the solar spectrum. We should, therefore, know which of these three solar radiations is predominant in the phenomena of the germination of seeds and the growth of plants; in the decomposition of the carbonic acid of the atmosphere and the fixation

* Annales des Sciences Naturelles. Botanique. 1864. Vol. i, pp. 314–324.

of carbon in their tissues; and in the production of the green substance or *chlorophyl*, these constituting the three great physiological acts of the vegetable kingdom. Unfortunately all the experiments yet undertaken are so contradictory that on this point there still exists in science the greatest confusion, and in practice they have naturally remained without application. In order that scientists and agriculturists may verify or make use of these experiments, we briefly mention them.

The paleness or whiteness of the parts of vegetables, when they are sheltered from the action of light, called by the moderns the *etiolation* of plants, did not escape the observing mind of Aristotle, who described it correctly enough, only he wrongly believed that the roots owed their paleness to their underground position; for they do not become green when exposed to light, and those which grow there are white. Still some roots are in themselves green, with or without the production of green matter or chlorophyl. The celebrated botanist, John Ray,* first among the moderns, proved in 1686, by many experiments, that light alone exerts an influence upon the green color of plants, that they scarcely vegetate at all under an opaque vase, and that their stems become extremely elongated; this phenomenon was neither owing to the want of air, nor to the influence of heat. Charles Bonnet established† that it was owing to the dark. Meese ‡ and Senebier § analyzed the cause and the circumstances. Michellotti || also first proved that light was injurious to germination, and Ingenhousz ¶ and Senebier ** found that seeds germinate more rapidly in the shade than in sunshine. After the tendency of stems to turn toward the light, three other phenomena were discovered at the commencement of this century relating to the influence of solar rays upon vegetation. Thomas Andrew Knight indicated for the first time in 1812 the tendency of some stems to shun the light in place of seeking it, and Dutrochet †† demonstrated it in the most incontestable manner. Dutrochet ‡‡ himself pointed out, in 1824, the tendency of roots to turn toward the light, and, in 1844, J. Payer §§ discovered the contrary disposition in other roots to shun the light. I pass over for want of space other less important facts which have been since discovered.

After recognizing the action of natural and artificial light upon the growth of plants and the production of green matter, we will proceed to study the influence of the different colors of the spectrum upon vegetation, by the aid of colored glass and liquids, and later by the colored rays of the solar spectrum; it is in these delicate experiments that observers disagree, as we shall soon find out.

Senebier, |||| who appears to have been the first to take up this important question, published in 1783 experiments which he began seven years before, which were continued during four years. His conclusions are as follows: 1. The size of the stems and their whiteness are so much the greater as the plant's illumination is less; but the green color of the

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* Historia generalis plantarum. 1686. Vol. i, p. 15.

† Recherches sur l'usage des feuilles dans les plantes. Gottingue and Leide, 1754. Pp. 209, 330.

‡ Journal de Physique. 1775. Vol. vi, part ii, pp. 445–449; 1776, vol. vii, part i, pp. 112–130, pp. 193–207.

§ Mémoires Physico-Chimiques, etc. Paris, 1782. Vol. ii, p. 75 and ff.

|| Journal de Physique. Paris, 1801. Vol. lii, pp. 185–194; 1802, vol. liv, p. 140–158.

¶ Journal de Physique. Paris, 1786. Vol. xxviii, pp. 81–92.

** Work cited.

†† Comptes-Rendus de l'Académie des Sciences de Paris. 1837. Vol. iv, pp. 486–491. Collection de Mémoires. Vol. ii, p. 60.

‡‡ Comptes-Rendus de l'Académie des Sciences de Paris. 1846. Vol. xxii, p. 320.

§§ Comptes-Rendus de l'Académie des Sciences de Paris. 1843. Vol. xvii, pp. 1043–1045.

|||| Works cited. Vol. ii, pp. 55–70, 103–105, 195–207.

leaves does not follow this rule absolutely. 2. The highest illuminating rays, the yellow and red, do not give to leaves the most decided green tint; the violet ray produces this effect with the lowest illuminating power. Senebier draws the conclusion that the green color will be deeper when there is less light reflected from the leaf and more penetrating it, and on account of this the violet ray gives the leaves a deeper green than natural light. 3. After the violet rays, plants become more developed in the red rays than in the yellow.

By submitting plants to the action of light transmitted through glass of different colors, l'Abbé Tessier* remarked, in 1781, that the intensity of the green tint of leaves went on decreasing from white glass to deep yellow; that leaves become sensibly green under the influence of lamps and of the light of the moon. He also observed that the stems are very strongly inclined when we place black materials behind the plant; the inclination is very feeble when the stuff is white; and it is almost nothing when we place a looking-glass behind the vegetable. Leaves which were placed behind a pane of white glass were green; less, however, than if the pot had been outside of the apartment. Leaves behind a pane of blue glass were still more green, there being between them and the preceding a sensible shade. Leaves behind a clear yellow pane differed from the last only by being a shade less green. In fine, the least green of all were those which had been placed behind a deep yellow pane; the difference was striking.

In 1817, Dr. Sebastian Poggioli,† instead of submitting plants to light transmitted through colored glass, conceived the happy idea of placing them under the rays of the solar spectrum. He observed, after the third day, that the smallest plant submitted to the violet rays, surpassed, in development, those under the influence of the red rays, the latter, on the fourth day, appearing to be blanched. The cotyledonous leaves of the plantlets in the two vases changed their positions, and directed their upper surfaces one toward the red light, and the other toward the violet. The direction was more rapid with the plantlets submitted to violet rays than with those which had been submitted to red rays. The two cotyledonous leaves which crown the plantlets of *Raphanus rusticanus* directed their upper faces, in the first place, toward violet light, and in the second, toward red. The seeds of *Brassica eruca* germinate more promptly under the influence of red rays than under green rays, and more promptly under green than violet rays.

In 1830, Adolphe Brogniart and de Jussieu saw the two opposite leaves which terminate the plantlets of *Alsine media* direct in the same manner their upper faces toward the red light to which alone they were submitted.‡ Thus the phenomenon was the same as that observed twenty-seven years before by Poggioli. Brogniart remarks that he had observed, as had Charles Morren, that the yellow rays approached, in their action, nearer than any of the others to white light; but, as this depended upon the fact that yellow glass allowed a very large quantity of white light to pass through it, while green and blue passed but a little, and red glass none at all, the intensity of light differed extremely in all these experiments.

In 1832, Charles Morren,§ by the aid of experiments with colored glass, reached the following conclusions: 1. That the colors of the spec-

* Mémoires de l'Académie des Sciences de Paris. 1783. Pp. 133–156.
† Opusculi Scientifici. Bologna, 1817. Vol. i, p. 9.
‡ Annales des Sciences Naturelles. 1832. Vol. xxvii, pp. 205–206. L'Abbé Moigno, Répertoire d'optique moderne. Paris, 1850. 3me partie, p. 1119.
§ Annales des Sciences Naturelles. 1832. Vol. xxvii, pp. 201–205.

trum, with the exception of green, only, like darkness, assist germination as their illuminating power becomes less. 2. That under the colored rays of greatest illuminating power, the radicles develop least and slowest, and that the plumules, on the contrary, grow best and quickest. 3. That under the rays with low illuminating powers, the radicles and plumules develop as they do in the shade. 4. That, consequently, the etiolation of vegetables, under the prismatic rays, happens in inverse proportion to their illuminating property. 5. That the green color of vegetables is developed much more rapidly under the influence of composite light than under decomposed rays. 6. That the yellow rays possess the maximum, and the orange rays the minimum degree of coloring plants green, and the other rays do not turn them green at all. 7. That the yellow ray greens them more when it is less intense, but that it requires much more time to produce this effect than white light does, and that it can never produce the same depth of color.

In 1837 and the following years Dutrochet made a great number of experiments upon the influence of light on vegetation. None of the stalks of *Lepidium sativum* showed the least inflection toward light transmitted by red glass. At the end of eight days they had increased considerably in length, but remained straight and vertical. These observations completely confirm those of Payer upon the same plant. On the contrary the stalks of *Alsine media* were, at the end of three days, all turned towards light transmitted through red glass. On turning the vase in such a way as to direct the inflection of the stalklets toward the base of the apparatus, four hours afterward they were bent anew toward the red light. Dutrochet then proved that this depended on the size of the stalklets of the two plants; that the only plants bent toward red light were those whose diameter was less than fifty-five-hundredths of a millimetre; a tenth of a millimetre difference between the diameter of one stalklet and another of the same species, near a certain limit, sufficed to bend one toward the light, and leave the other in its natural position.

The experiments of Dutrochet prove that the stalks of plants are bent toward red light transmitted without mixture by glass of this color; while, according to Payer, they inclined toward blue or violet light. Dutrochet here raises an important question, whether it is not the luminous intensity of the colored rays which determines the inflexion of vegetable stalks, an intensity varying with the transparency of the glass. The first flexion in the stalks toward the light is shown without exception in those submitted to the violet rays; afterward, in the indigo and blue rays, and ordinarily at the same time in the lavender rays which form the almost invisible continuation of the spectrum beyond the violet; then in the yellow and green rays, in the orange, and finally in the red rays. Beyond violet the flexion of stalks reaches twenty and sometimes even thirty centimeters, according to the intensity of the light; but beyond the red rays the flexion of the stalk extends very little.

Previous to 1837, Doctor John William Draper, of New York, having made several experiments on the action of different rays of the solar spectrum, concluded that the yellow ray, the most luminous, had the power of producing chlorophyl. Plants become also green in light that has been submitted to the action of the yellow solution of bichromate of potassa, and so deprived of those rays which blacken chloride of silver; the same is true of light which passed through sulpho-cyanate of iron, and sulphate of copper and ammonia; in every instance the leaves

becoming green. Seeds of common cress were caused to germinate and grow under these circumstances.*

"It is not this or that ray," adds Draper, "which gives rise to the color of beans. The absence of the chemical ray or the calorific ray does not appear to effect it, nor have we any direct proof that the calorific ray exerts any influence. Humboldt has stated that in the mines of Germany plants grow in recesses where the sun's light never comes, and, provided hydrogen gas be present, the color is green. In the abysses of the ocean, at depths to which no solar beam can penetrate, and where there is perpetual night, green plants are found flourishing. Light, which seems to act merely as a stimulus on the green organs of vegetables, indirectly bringing about the decomposition of carbonic acid, though accessory, is not, however, essential to the growth of plants."†

From 1840 to 1847 Robert Hunt‡ was engaged in an extensive series of experiments on the process of germination and vegetable growth as affected by solar radiations. These experiments were undertaken under the auspices and at the expense of "The British Association for the Advancement of Science."

The results to which he was led are:

1. Light prevents the germination of seeds, as was formerly asserted by Michellotti, Ingenhousz, Meese, Senebier, and others.
2. Actinism, or chemical rays, quickens germination.
3. Light acts so as to effect the decomposition of carbonic acid by the growing plant.
4. Chemical action and light are essential to the formation of the green matter of the leaves, or chlorophyl.
5. Light and chemical rays, independently of the calorific rays, prevent the development of the reproductive organs of plants.
6. The heat radiations corresponding to the extreme red rays of the spectrum facilitate the flowering of plants and the perfecting of their reproductive principles.

As to the conditions in which the luminous, chemical, and caloric principles exist in light during the different seasons, he has found that—

In the spring chemical action is the most powerful, and is in very considerable excess of pure light and heat.

As summer advances the quantity of light and heat increases to a very great degree above chemical action.

In the autumn, light and chemical action both diminish, and the calorific radiations predominate.

These facts bear strikingly upon all Hunt's experiments; they appear to confirm his conclusions in a most satisfactory manner, and also to point to a singularly interesting order in nature, which is the following:

In the spring, when seeds germinate, and young vegetation awakes from the repose of winter, we find an excess of the principle which imparts the required stimulus—that is of *chemical action*; seeds then germinate, and young buds and shoots are developed. In the summer this exciting agent is counteracted by another possessing different powers, upon the exercise of which the formation of the plant's structure de-

* Philosophical Magazine. 1840. Vol. xvi, pp. 81–84.

† Journal of the Franklin Institute. 1837. Vol. xx, pp. 250–253.

‡ Philosophical Magazine. 1840. Vol. xvi, pp. 271–274. Reports British Association. 1842. Part I, pp. 75–80. 1843. Part II, p. 35. 1844. Part I, pp. 29–32. 1846. Part I, pp. 33–34. 1847. Part I, pp. 17–30. For the theoretical conclusions see Reports for 1846 and 1847. Researches on Light, &c. London. 1844. 8vo., pp. 165–202. The Poetry of Science, &c., London. 1848. 8vo., pp. 335–362.

pends—that is *luminous action.* As the sun becomes more active the formation of woody fiber proceeds under this agency, and the chemical power is rendered less active by the purity of the light. Finally, in the late summer and in the autumn these are checked by another agency with diminished powers of light, upon which the development of the flower appears to depend, the ripening of the fruit, and the perfection of the seed—and this is *thermic action.*

The experiments of Hunt have also led him to detect some curious influences which appear due to dissimilar rays, and in their action exhibit great inconstancy of effect. One class of rays, the same to which Sir J. Herschel has given the name of *parathermic* rays, are so subdued by the influence of more refrangible rays, as to be nearly inactive during the spring and early summer months; indeed in the spring they scarcely produce any effect upon dead vegetable coloring matter, unless their action is assisted by the use of some decomposing agent such as sulphuric acid. These rays increase in power toward autumn, and to them appears due the browning of the leaf.

In all his writings Hunt has repeatedly stated that seeds would not germinate under the influence of light, when deprived of that principle on which chemical change depends; and has declared as a *law*, that in its relation to vegetable life, light prevents germination. This statement has been decidedly objected to by Doctors Draper and Gardner, of New York.

By numerous experiments Hunt also found that the chemical principle of solar radiation produces an acceleration of the germinating process, so that in every instance the seeds influenced by these chemical rays germinated in one-half the time required by the seeds placed in the dark. In ascertaining if the influence of the chemical rays was confined to the surface of the soil, or extended below it, he obtained the most satisfactory evidence, that under the rays which passed through blue glass, germination began at a depth below the surface, where it did not take place under ordinary conditions. In every instance germination through the agency of radiations, which had permeated the blue-glass in less time, and to a greater depth in the soil than was possible in comparative experiments where the seed was exposed to the full influence of light and its associated radiations as combined in the solar beam.

As to different colors of light, Hunt says, that if the young plant, continues to grow under the influence of blue rays, it will for some time exhibit luxuriance and present in its earlier stages an appearance far superior to that of plants grown under other influences, or even white light. The leaves will be of a darker green, and altogether show external signs of vigorous health. Even in the earliest stages it will be found that the plants grown in the full sunshine, or under yellow or red media, representing the luminous and calorific principles, give a larger quantity of woody fiber and less water than those grown under chemical influence. Plants growing in the shade, in like manner, contain more water than those in full sunshine; hence, we cannot infer that anything more than the deprivation of light influences the condition of plants in these experiments. He ascertained that as great a difference exists in the quantity of water found in plants growing in artificial shade, and plants of the same class growing unsheltered, under the ordinary conditions of sunshine. It is therefore evident that all those experiments, which have been made on the increase of grass crops by littering the fields with the boughs of trees and the like, are liable to the error alluded to; and it is questionable if the increased product of an acre is

not principally due to water, rather than to any carbonaceous product; consequently the increase of the nutritive property is not in the ratio of the increase of weight.

Hunt further observes that it frequently happens, when the media employed cut off a large quantity of light, and admit the chemical principle freely, that no formation of leaves takes place after the development of the plumule or first leaf bud; the ground stem, instead of solidfying, remains soft, and without increasing in diameter, extends to an enormous length. Nothing like this occurs under the influence of either light or heat. It would appear that this abnormal condition is due to the excitement of the chemical rays, acting possibly with great power upon the living principle in the roots, by which the elaboration of some organizable matter is produced, which they supply as food to the stem. As there is but little power to decompose carbonic acid, there is not the necessary supply of carbon to give rise to those stems and leaves which naturally form upon the primitive stem.

That this is something like a true explanation is further proved by the fact, that in the practice of planting shoots, the use of blue media is highly advantageous. It appears to increase the tendency to develop roots, and it is satisfactory to learn that some gardeners have, without any knowledge of the cause, employed cobalt blue-glass to aid in the striking of cuttings.

According to Senebier, plants decompose the carbonic acid absorbed by their leaves much more readily under the influence of violet rays than under any other. In his early experiments Hunt thought he had found the correctness of Senebier's opinion. Dr. Daubeny and Dr. Gardner both think that the decomposition of carbonic acid increases with the increase of light, and that it is more rapid under the influence of the yellow ray than any other. In the experiments of Hunt, by which the quantity of woody fiber increases with light, this agent seems to be essential to its formation. But Hunt explains this fact by saying that the decomposition of carbonic acid by plants under the agency of light is not a simple chemical operation, as has been supposed by some, effected by the chlorophyl, but the result of an exertion of the vital principle of the growing plant which requires the external stimulus of light to call it into action.

Hunt seems to have discovered a capital point, to which he has not himself done justice, and which has passed entirely unacknowledged by other observers. It is that in all his experiments he has found that each variety of plants employed was influenced by *different* rays. Cress and mustard, for example, become green most rapidly in the *green* ray, mignionette in the *yellow*, and peas in the *blue* ray. He observes, however, that the influence was always most decided between the limits of the mean orange and the mean blue ray, and that it took it much longer to green plants in the red than in the blue ray.

The importance of this discovery, should it be confirmed, will consist in showing the action of light upon plants to be identical with that of heat. If each plant, as we have seen above, possesses its own zero of temperature and requires a certain different degree in order to accomplish each of its physiological functions, in light the greening of the leaves or production of chlorophyl (and probably the decomposition of carbonic acid and the fixation of carbon) needs also the chemical action of a certain colored ray of the solar spectrum. The difference existing between each color of the spectrum being only a difference in greater or less velocity of vibration, and of properties purely relative, as in heat and light, each plant will be therefore chemically affected by rays

of different colors. At least this is the conclusion from Hunt's experiment.

In fine, Hunt thinks that the manner in which the power of solar radiation is exerted on seed beneath the soil is not clear to us. We do not know whether it is a mere disturbance of *something* already diffused through matter, or in the seed, or an emanation from the sun. All which we are enabled to declare is that "the germination of seed is more rapid under the influences of chemical rays, separated from the luminous, than it is under the influence of the combined radiations or in the dark." That the formation of chlorophyl is not directly dependent upon either light or chemical action, regarded as isolated principles, but on the action of both forces acting upon plants.

"It has been stated by Dr. Gardner," adds Hunt, "that plants exhibit a lateral movement bending toward the yellow ray. This appears to be a mistake; plants under the influence of the red rays bend from the light but along the line of the ray; and those exposed to the most refrangible rays turn toward it, but still in the line of the ray. Now the plants which first become green, by careful treatment in this way, are those exposed to the rays between the mean green ray and the extreme blue. The action is continued eventually to the edge of the most refrangible violet below the yellow ray. No change is effected beyond the visible spectrum, notwithstanding the abundance of dark chemical rays; and the change is shown only where there is really the largest amount of light. I therefore conclude that the luminous rays are essential in producing the decomposition of the carbonic acid and the deposition of carbon, which is afterward, in all probability, continued with hydrogen under the influence of the purely chemical rays of solar light." Finally, Robert Hunt communicated a letter to the British Association at its meeting in 1853, from Messrs. Laws & Co., of Edinburgh, in which it was stated that by adopting the plan of cutting off luminous rays by the use of cobalt blue-glass, as recommended by Hunt, they succeeded in obtaining healthy germination far more rapidly than in ordinary circumstances. They constructed a house glazed with blue glass, and in this their seeds were tested. The practical application of a scientific discovery was of the utmost value to them. Tropical seeds, under the same circumstances, were found to germinate in a few days, when in ordinary conditions many weeks were required for the process.*

According to l'Abbé Zantedeschi, Carradori had, in 1841, confirmed the results of Senebier so far as that the power of light to color vegetables green resides in an eminent degree in the violet and blue rays, although it is more feeble than in ordinary light.†

In 1843, J. Payer,‡ by making use of colored glass and afterward of the solar spectrum, found that the tendency of stems toward the light was so much greater as the light was less intense or reached a lower point. As the plant found between two luminous rays of different intensities is always curved on the side of the stronger light, between the blue and violet, the blue region has always the greater amount of this action, and in it is found the maximum. But Payer has not studied the action of invisible chemical rays beyond the violet, upon the flexion of the stems, as Guillemin has done later, although Hunt found no influence upon vegetation in the ultra-violet rays. I am also inclined further

* Report British Association. 1853. Part II, p. 63.

† Comptes-Rendus de l'Académie des Sciences de Paris. 1843. Tome xvi, pp. 747–749.

‡ Comptes-Rendus de l'Académie des Sciences de Paris. 1843. Tome xv, pp. 1194–1196. 1844. Tome xviii, pp. 32–36.

to believe that Hunt has not paid attention enough to the obscure and chemical rays.

In 1842, l'Abbé Zantedeschi* drew the following conclusions from his experiments upon the influence of solar rays transmitted by colored glass:

1. Vegetation under the influence of light transmitted by any kind of colored glass is languishing and sickly, as was observed by Senebier and Carradori.

2. The order observed for germination under colored glass is different from that observed by Senebier.

3. Violet light has a power little inferior to that of ordinary light to green certain vegetables, as Senebier has said: the balsam is in this condition but it does not take place with *Oxalis multiflora.*

4. As to the vigor of vegetation it is no greater under violet glass than under yellow and red glass, as Senebier had observed.

5. Green light is less favorable to vegetation than red light.

6. The most vigorous vegetation for *Oxalis multiflora* takes place under blue glass.

In 1844 Dr. D. P. Gardner,† of New York, claimed to have settled the question beyond dispute that the yellow rays produce chlorophyl in leaves, as Dr. Draper had first advanced; but he is in complete disagreement with Hunt and other experimenters. Here are his conclusions:

1. That chlorophyl is produced by the more luminous rays, the maximum being in the yellow.

2. This formation is due to pure light.

3. That the ray toward which plants bend occupies the indigo space in Fraunhofer's lines.

4. This movement is due to pure light as distinguished from *heat* and chemical action.

5. That pure light is capable of producing changes which result in the development of palpable motion.

6. The bleaching of chlorophyl is most active in those parts of the spectrum which possess no influence in its production and are complementary to the yellow rays.

7. This action is also due to pure light.

In the same year Robert Harkness,‡ of England, objected to Gardner's conclusions, and made the following very judicious remarks, which were approvingly quoted by Hunt: "If the absence of solar light is one of the conditions almost necessary for the germination of seed, one should not expect that ray in which the maximum of light is found, to facilitate germination; but on the contrary, according to Hunt, to retard it. If, again, the yellow ray is the operating cause by which carbonic acid is decomposed and chlorophyl produced, we should also expect that, so far from assisting in germination, it would exercise a highly injurious influence. We know that the presence of oxygen is necessary for the vegetation of seeds, also that this oxygen is absorbed, and by uniting with a portion of the carbon in the seeds reappears in the form of carbonic acid, a process the opposite of that which takes place when chlorophyl is produced. So that if the decomposition of carbonic acid is owing

* Memoire dell' Instituto Veneto. 1843. Tome i, p. 269. Atti dell' Instituto Veneto. 1844. Tome iii, pp. 63–67. Comptes-Rendus de l'Académie des Sciences de Paris. 1843. Tome xvi, pp. 747–749.

† American Journal of Science. 1844. Vol. xlvi, pp. 1–18. Jameson, Philosophical Journal of Science. 1844. Vol. xxxvii, pp. 76–94. Philosophical Magazine. 1844. Vol. xxiv, pp. 1–15.

‡ Philosophical Magazine. 1844. Vol. xxv, pp. 340, 341.

to the yellow ray, this same ray ought to be the last to produce any effect on the germination of seeds. Moreover, seeds, as well as fully developed vegetables, possess the power when deprived of light of absorbing oxygen and evolving carbonic acid; and to this circumstance we must ascribe the effect of the blue ray shown by Hunt's experiments."

In 1850 Cloez and Gratiolet advanced the opinion that the decomposition of carbonic acid by the green parts of plants with the aid of colored glass is at its maximum with colorless polished glass; next comes yellow glass, then colorless transparent glass, red, green, and in the last place blue glass.*

In 1852 J. H. Gladstone,† in experimenting with peas, drew the following conclusions, in entire opposition to Hunt's experiments: The cutting off of the chemical rays favors the first germination of the seed, and this appears to be the principal, if not the only advantage obtained by burying the seed in the soil. The development of roots also requires the absence of the chemical ray, yet it does not go on to the greatest extent when all the solar influences are excluded, but is favored, rather than otherwise, by heat and luminosity. The first development of the plumule also proceeds best under the same circumstances; yet these are not the conditions which produce a healthy plant; if all the solar radiations are withdrawn, whether entirely or only to a great extent, the plants absorb much water and grow very tall, without developing secondary branches or many leaves. The whole force of these radiations, on the contrary, prevents or greatly impedes the growth of those plants under the circumstances of the experiments. The chemical force is the most antagonistic to the growth of the pea, and luminosity also militates against it; the heating rays are favorable. If the plant is fairly established, those radiations which are, comparatively speaking, devoid of light, but replete with chemical power, are the most suited to a healthy growth. The influences which facilitate rapid growth are diametrically opposed to healthy development. Upon the question whether the yellow light stops germination by some specific action or merely by excess of light, Gladstone says that the yellow light did not at all interfere with germination in his experiments. In the case of wheat and peas it decidedly facilitated the early development of both root and plumule. He thinks that the yellow ray, however, has a specific action of its own, and that the yellow and obscured yellow give quite different results from those of any other glasses. On the whole, Gladstone's experiments are in accordance with Draper's. In one or two cases, the seeds exhibited a tendency to germinate more readily under a blue glass.

In 1854, Robert Washington,‡ in some experiments made on the influence of colored glass on the growth of plants in sea-water, found that red sea-plants grew best in cases whose light was allowed to pass through green colored glass, and that the brown and green confervoid growths were thus destroyed.

The first observer, as far as I am aware, who studied the action of the ultra-violet or invisible rays of the spectrum upon vegetation, and according to exact scientific methods, was C. M. Guillemin. His first care was to vary the nature of the prisms which he employed, in order to turn to account the special transparency that each prismatic substance presented to rays of different refrangibility. He chose, for instance, *quartz* for all rays more refrangible than blue, *rock-salt* for the red and calorific rays,

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* Comptes-Rendus de l'Académie des Sciences de Paris. 1850. Tome xxxi, p. 627.

† Report British Association. 1852. Part I, pp. 239–243, 1854; Part I, pp. 373–386. 1855. Part I, pp. 15–18.

‡ Report British Association. 1854. Part II, p. 103.

and *flint* for the mean rays of the colored spectrum. *Heavy flint*, which he had also employed, is the most dispersive of all; but it absorbs in great part the calorific and ultra-violet rays, transmitting only the least refrangible of them.

In a paper presented to the Academy of Sciences of Paris, in 1857,* Guillemin reached the following conclusions:

1. The ultra-violet rays determine the formation of the green matter of vegetables.

2. These same rays effect the flexion of the stems more rapidly than the rays of the visible part of the spectrum.

In a second paper to the same academy† he acknowledged that in his first communication he had given as certain the first proposition, but that he had some doubts on the second; further researches, however, had fully confirmed both of these prior propositions. His conclusions are the same as those he afterward published in a third, more extended work.‡ They are as follows:

1. Young etiolated plants curve under the influence of all the rays of the solar spectrum; the least refrangible calorific rays or those of low temperature appear to form the only exception.

2. The calorific rays less refrangible than the red, and the chemical rays more refrangible than the violet, present two *maxima* of action for the flexure of vegetal stems; intermediate colored rays determine, on the contrary, more actively than the preceding the formation of chlorophyl.

3. The primary maximum of flexion is situated between the lines H and I, in the ultra-violet rays.

4. In the spectrum obtained with a quartz prism, the limit at which the flexion of the stem ceases, passes beyond that of rays more refrangible than violet, indicated by fluorescent substances and iodide of silver.

5. The second maximum of flexion of the stems, less pronounced and less fixed than the first, is situated in the calorific region; this maximum approaches so much the nearer to the lines E and b in the green, as the height of the sun above the horizon is less, or as the atmosphere is more charged with vapors which disturb its transparency.

6. These two maxima are separated by the minimum, which is situated in the blue rays, near Fraunhofer's line F.

7. Lateral flexion extends beyond the red and violet extremes; its center is in the indigo rays; it is often produced in spite of screens, which separate the different colored rays.

8. The development of green matter has its maximum in the yellow· it diminishes slowly as it proceeds toward the violet, passes this limit, and becomes *nil* in the last fluorescent rays.

9. On the red side, the aptitude of the diverse rays to determine the formation of the green matter, diminishes more rapidly; the orange and red rays possess this quality in a high degree; it diminishes in the vicinity of line A, passes this limit, and ceases in the calorific rays, near the maximum of heat.

10. Blue, green, yellow, orange, and red rays turn etiolated leaves green more quickly than direct solar rays. The action of yellow is almost equal to that of diffused atmospheric light.

11. Polarized rays appear to act at close intensities, like common rays.

12. The principle of the identity of radiations, which already rested

* Comptes-Rendus de l'Académie des Sciences de Paris. 1857. Tome xlv, pp. 62–65.
† Comptes-Rendus de l'Académie des Sciences de Paris. 1857. Tome xlv, pp. 543–545.
‡ Annales des Sciences Naturelles. 1857. Tome vii, pp. 154–172.

on the observation of a large number of physical phenomena, is here fully confirmed in the physiological order, by the analogy of the mode of action which the calorific and ultra-violet rays exert upon the flexion of stems and the development of green matter.

Unhappily for these important researches, if we compare Guillemin's first conclusion with the eighth of his second note, we find a flagrant contradiction upon a question of the highest importance, the maximum action of the colored ray of the solar spectrum, under the influence of which the formation of the green matter or chlorophyl takes place. According to the first conclusion it is in the *ultra-violet* rays that this is produced, while in conclusion eight it is in the *yellow* ray, and even diminishes slowly when proceeding toward the violet. Thus it is wholly the reverse of the first case. Such a contradiction throws a weighty doubt on the whole of these experiments.

In the following paragraph we see that Professor Henry agrees with Robert Hunt and myself as to the noxious influence of light on the germination of seed:

> Germination can be carried on in the dark, and, indeed, the chemical ray which accompanies light retards rather than accelerates the process. Its office is to separate the atoms of carbon from those of oxygen in the decomposition of carbonic acid, while the function of the power within the plant results from the combination of these same elements. The forces are therefore antagonistic, and hence germination is more rapid when light is excluded; an inference borne out by actual experiment.*

In 1869, Dehérain† proves that the evaporation of water by the leaves of plants takes place under conditions entirely different from those which regulate the evaporation of an inert body, as it occurs in a saturated atmosphere; that it is especially affected by light; and that the luminous rays efficacious in causing the decomposition of carbonic acid by the leaves, are also those which favor evaporation. The *yellow* and *red* rays, which have little action on photographic paper, act with most intensity in causing the reduction of carbonic acid, while the *blue* and *green* rays decompose the chloride of silver, and have no action on the leaves. These experiments confirm the old observation of Guettard, that the hard and smooth upper part of the leaves evaporates the most water. Boussingault has shown that the greatest amount of carbonic acid is decomposed by the same portion.

We have not succeeded in obtaining the following authors:

Surcow, cited by Guillemin,‡ who has found that violet, blue, green, and red colors powerfully influence the development of the green parts of plants, while yellow produces no more effect than darkness.

R. Kunth has published a memoir on the influence of colors on germination.§

In another paper Kane, according to l'Abbé Moigno,|| has confirmed the views of Draper and Gardner.

According to Senebier,¶ Lambert** has made and described some very interesting experiments on the relations between the violet and red rays and the vegetation of beans.

Poggendorff's *Bibliographical Dictionary* mentions a work by Gioa-

* Report of the Commissioner of Patents for 1857—Agriculture, p. 446.

† Comptes-Rendus de l'Académie des Sciences de Paris. 1869. Vol. lxix, pp. 381, 929.

‡ Thèse sur la Composition de la Radiation Solaire, son Influence sur les Êtres Vivants. Paris. 1856. Tome iv, p. 38.

§ Hort. Univ., Tome iv, p. 423.

|| Répertoire d'Optique Moderne. Paris, 1850. 3ieme Partie, p. 1131.

¶ Mémoires Physico-chimiques. Geneva, 1782. Vol. ii, p. 67.

** Photometria sive de mensura et gradibus luminis, colorum et umbræ. Aug-Wind, 1760, 8vo.

chimo Carradori, entitled "Sopra la distruzione del color verde operata della luce in alcuni vegetabile viventi," published in Burgnatelli, *Giornali di Fisica*, 1809, vol. iii. I do not know if this is the same author cited above by l'Abbé Zantedeschi, as the dates are different.

CONCLUSIONS.

After the long series of experiments I have announced, and which each one should utilize for himself, I must formulate my own conclusion, which I advance only with the title of hypothesis until I have the means of submitting it to experimental test.

I remark first, that these experiments have been performed after different methods, and are therefore not to be compared with each other. Some experimenters have made use of colored glasses, others of colored liquids or solutions, and others still of the solar spectrum. In these three methods the nature and action of the colored rays must have undergone modifications so various as to make the results very discordant. For example, the most of colored glasses are impure, because they allow white light and various tinted rays to pass, besides those of their own proper color. Yellow and green glasses, which are usually too clear, allow a great amount of white light to pass. The thickness of glass, the density of liquids, and the composition of analyzing prisms, are points of the highest importance, which no one has taken into account, and which modify greatly the tints of colored rays.

Another cause of error is, that each observer is contented with submitting the plant to the action of this or that colored ray, and not to each of the seven colors of the spectrum. In short, no observer except Guillemin, not even Hunt, conceived the idea of studying the influence of invisible rays beyond red and violet, which afford: the first, the maximum of calorific action; the second, the maximum of chemical action.

These are errors of method only, without counting the personal errors of experiment, or even the errors which could result from the physiological and physical action of the plant. We have already seen, in the case of Dutrochet, that *one-tenth of a millimetre's* difference in the diameter of two twigs of the same species was enough to bend one toward the light and the other away from it.

In analyzing the action of light on vegetables, three great physiological acts of the plant must be considered: 1st. The germination of the seed. 2d. The decomposition of carbonic acid from the atmosphere and the fixation of carbon by nutrition in the tissues of the plant, which results in the formation of chlorophyl. 3d. The flowering and fructification.

In germination, according to Theodore de Saussure, we should distinguish two periods, the one during which oxygen is transformed into carbonic acid, which is the period of germination, properly speaking; the other during which carbonic acid is decomposed and oxygen is exhaled, which is the commencement of vegetation. The green color in which the plant clothes itself is the index and the consequence of that function which takes place only under the action of light; in its absence the plant continues the phenomena of the first period of germination without development, and remains colorless.

If the physicists who have studied the influence of light on germination had taken the chemico-physiological action which it wrought in the plant more into consideration, they would not have committed another grave error, as Gladstone has done, in saying that the yellow rays, which possess the maximum of luminous power, and by consequence the minimum of chemical force, could in any manner favor the germination

of seeds. The physicists who sustain this opinion have not sufficiently distinguished germination from vegetation, properly speaking. During germination the plant loses the carbon furnished by the carbonic acid, and only respires. On the contrary, during vegetation the plant retains the carbonic acid, fixing the carbon and drawing in oxygen, and therefore the functions of nutrition and assimilation of plants do not really begin till the moment of the appearance of green matter. The relations of plants and light are altogether different during the two periods; injurious during the period of germination, light is, on the contrary, indispensable in the second period of vegetation.

It is for this the plant seeks always after light. Its shoots cling toward the side of incidental rays and inflect themselves constantly in that direction. It is a phenomenon general in plants, from the phænogamia to the cryptogamia, and in microscopic vegetation. Light is as indispensable to the nutrition of plants as the gastric juice is to digestion and the transformation of food. The assimilation and fixation of carbon in plants is greatest and most rapid when, all other things being equal, the supply of light is greatest.

In the light of the solar spectrum, besides the special property of the seven colors which reduce themselves to three primary ones, three forces also are found intimately combined and working simultaneously. These are the *luminous*, the *calorific*, and the *chemical* force. Each one of these three great powers acting diversely on inorganic matter, there is no reason why they should not act equally after their nature on organic matter, whose chemical elements are the same. In fact, modern chemistry conclusively demonstrates that the vegetable, like the animal kingdom, is formed of but four elements, carbon, oxygen, hydrogen, and nitrogen. These four elements being combined in the most diverse and variable relations, it results that an innumerable quantity of organic components enjoy properties most distinct. On the other side, these four simple bodies are precisely those which constitute the atmospheric air. We can say with Dumas, that the whole vegetable kingdom is only the air condensed, and that it forms a vast apparatus of reduction. The base of these vegetable productions is always the same, the atmospheric air; the arrangement of molecules and their number is all which varies for constituting that mysterious force which one commonly calls *life*.

From these considerations we establish hypothetically—

1. That it is the purely *chemical* rays or ultra-violet with the aid of a certain quantity of obscure heat found mixed with the rays, which penetrate the vegetable stratum of the soil and determine the germination of seeds.

2. It is the purely *luminous* rays of the spectrum, the yellow, which determine, principally by the leaves, the decomposition of carbonic acid from the atmosphere and the roots, the fixation of carbon and the production of chlorophyl, and which explains the spontaneous and natural tendency of the plant to the light.

3. It is the purely *calorific* or *ultra-red* rays which determine the two physiological acts of flowering and fructification.

Now the *blue* and *violet* rays on one part, the *green* on another, and the *red* rays have a purely secondary action in the production of these three great physiological acts of the plant, as the *chemical*, *luminous*, or *calorific* actions predominate in the second place. But it must be remembered before all that what we call the *vital force* proper to the plant precedes and modifies at will the three actions of the solar rays, chemical, luminous, or calorific in all the physiological acts of the vegetable kingdom.

If this is true, we see at once the application to be made to agriculture and horticulture. First, in the arrangement of *greenhouses*, which leaves much to be desired at present. They should have compartments covered with pure glass, whose maximum *chemical*, *luminous*, and *calorific* properties would be more advantageous to each development of the plant. For example, in germination the glass should have *chemical* properties of the highest degree. For coloring the leaves and giving growth to the plant, glass should have the maximum of *light;* for flowering and fructification, the maximum of *heat*. As for the colors of the spectrum, the *blue-violet*, the *yellow*, and the *red* will yield the most advantage in these physiological acts of the plant.

ON THE ACTION OF LIGHT IN THE PRODUCTION OF CHLOROPHYL AND AMIDON.

Generally speaking, all the green organs exhale oxygen; and, reciprocally, all those which decompose carbon, are green. What relations, then, connect the important vegetable function of the green matter and the physical movement which constitutes light? Of the force by whose application chlorophyl is formed we are ignorant. Life exists in vegetables, and it is by virtue of this life that the cellules have the power of forming it. We cannot but admire the means which the life uses, and the functions which are necessary to its elaboration.

The experiments of Bonnet, Hales, Percival, Priestly, Ingenhousz, Spalanzani, and especially Senebier, de Saussure, and De Candolle, have established that the decomposition of carbonic acid gas by vegetables was in intimate and constant relation with the green color. Link has found that it is not only the gas brought by the roots which is decomposed, but, also, that of the air which enters directly the stomates.

The chlorophyl, formed by chemical forces, exists, ordinarily, in the interior of the cellules of parenchyma, and the derm is often deprived of it. Link* observed in 1817 that the chlorophyl could present itself in a granulous form, vesiculous or lining the cellular internal partitions. Treviranus† demonstrated that the globules were derived from the green matter, at first without form; and Arthur Gris‡ also proved that the chlorophyl was elaborated by the nucleus, (whose importance in cellular nutrition seemed actually assured,) and appeared round it in the form of jelly, accumulating, or else drawn out by the rotary currents of which it is the centre. The gelatinous chlorophyl organizes afterward in granules.

Lecoutourier affirms that he knows no matter whose power of absorbing light is comparable to that of chlorophyl§. Kunth has proved also that the green has the property of absorbing more of the chemical rays than any other color.‖

Light acts as powerfully on the production of amidon in the grains of chlorophyl. This discovery is due to H. de Mohl,¶ and was afterward confirmed by Nageli. Sachs first demonstrated, in 1862, and 1864, that

* Grundlehren der Anat. und Physiol. der Pflanzen. Gottingen, 1817. P. 36.

† Beit. Z. Pflanzen physiologie, p. 78 et 83; Physiologie des Gewaechse. Bonn, 1835. Vol. ii, § 364.

‡ Recherches Microscopiques sur la Chlorophylle; Thèse, Paris, 1857. In 4°; Ann. des Sc. Nat. 1857. Vol. vii, p. 179. Bull. de la Soc. de Botannique de France. 1857. P. 154.

§ Coloration Industrielle. 21 Janvier, 1858. No. 26, p. 202.

‖ London and Edinburg Phil. Mag. and Journal of Sciences, vol. xvi, p. 270; vol. xvii, p. 261.

¶ Ueber die Anatom. Verhäl An. des Chlorophylls Tubingen, 1837; Ann. Sc. Nat. Série II. Vol. ix, p. 150; Botan. Zeit., 1855, Nos. 6 et 7; Ann. Sc. Nat., 4° série, 1856. Vol. vi, p. 139.

it is only when the plants have been submitted to sufficient light that this phenomena manifests itself. The amidon produced in light disappears in darkness, to appear anew under the influence of light. Since then, Famintzin* has proved the action of artificial and colored light on the formation of amidon in chlorophyl. He concludes that the formation of amidon is determined solely by the yellow light. In the blue light, on the contrary, as in the dark, amidon does not form; and if it exists it disappears little by little. Nevertheless, Edward Prilleux† has demonstrated lately that the formation of amidon depends principally on the brightness and intensity of the light; that it is not only formed by the yellow light, but also by the most refrangible rays, like the blue and the violet, when they are sufficiently bright to determine its production. Also the formation of chlorophyl as that of amidon, which deposits itself in the grains of that green substance, depends intimately on the brilliance of the light.

A point worthy of interest, says Dumas, is that these green parts of plants, which are the only ones to show the admirable phenomena of the decomposition of carbonic acid, are also possessed of another property, no less peculiar or mysterious. Were one to place these green parts in the apparatus of Daguerre, their image would not be found reproduced any more than if the chemical rays, essential to Daguerrian phenomena, had disappeared in the leaf, absorbed and retained by it. The chemical rays of light seem to disappear entirely in the green parts of plants—an extraordinary absorption, doubtless, but one which shows at once the enormous expenditure of force necessary to the decomposition of a body as fixed as carbonic acid.‡

INTERNAL ELECTRICITY OF VEGETABLES.

The causes which liberate electricity in organized bodies under the reign of life, or a little after it, are of three orders—*physical*, *chemical*, and *organic*—the latter belonging to certain vital functions not clearly defined.

There exist in vegetables an ascending sap and a cortical sap, the latter not having the same composition as the former, and, according to some physiologists, having a descending motion.§

Both are separated by tissues, and produce electric effects like those of a pair of galvanic plates. These effects are so much the more remarkable, as they relate to the formation of the bark and that of the wood. The parenchyma, which is analogous to the pith, occupies the circumference of the bark, while the pith itself is found at the center of the ligneous system. This inversion responds to reverse electric effects. Each stem or branch being composed of an interrupted series of heterogeneous concentric layers, their successive contact gives rise to electric effects rising from the heterogeneous liquids moistening these layers. The ascent of the sap is not only due to endosmosis and to capillary attraction, but also to the presence of buds, which draw from the stem

* Ann. Sc. Nat. 5 Serie, vol. vii, p. 177.

† Comptes-Rendus de l'Acad. des Sciences de Paris. 1870. Vol. lxx, pp. 521-523.

‡ Essai de Statique Chimique des êtres organisés. Paris, 1814. P. 24.

§ Biot's experiments tend to gain admittance for the circulatory movement of the sap. In examining the optical properties of the ascending sap, and of the parenchymous sap of the maple, he recognized that in the first the plane of polarization turned to the right; in the second, to the left—while in the birch, the action was inverse. These experiments, which establish, according to Biot, a reciprocal dependence between the two saps demonstrate their circulatory movement. What is certain is, that the parenchymous sap differs from the ascending sap. Annales de Chimie et de Physique, 1851, vol. xxxi p. 47.

and branches the substance for their development. The buds afterward are not slow in forming leaves, which become the seat of a continual evaporation, which concurs with the ascending motion of the sap, and influences the manifestation of electric effects. After the discovery of voltaic electricity, Dr. Baccomio* undertook to construct piles with organic matter of vegetable origin, as Metteucci has since done with portions of the muscles of different animals. The first experiments, however, had no value. Becquerel, Wartmann, and Donné, by means of metallic plates or wires in connection with a multiplier, obtained currents in vegetables and fruits. The existence of electric currents constantly circulating in vegetables, and between them and the earth, is manifested not only in the direct experiments which have been made, but according to the following physical considerations: In the vertical section of a stem, the ascending sap, before its entrance into the vegetable by the roots, is composed of water, holding in solution air, carbonic acid gas, and very small quantities of saline and organic matter removed from the soil. As to the parenchymous sap elaborated in the leaves, it loses insensibly a portion of its constituent parts for nutrition. Both saps are found in the conditions requisite to form contacts by insensible transitions, and consequently to produce electric currents without the intervention of metallic plates.

On the other side, the earth being in direct and permanent communication with vegetables, through the medium of the roots, participates in their electric state, resulting from the diverse elaborations which take place in their tissues, just as we have seen atmospheric temperature influence the heat of vegetables.

From very delicate experiments, confirmed by Riess,† Pouillet‡ concludes that the action of vegetables upon the oxygen of the air is one of the most permanent and powerful causes of atmospheric electricity. A gram of pure carbon, in changing to the condition of carbonic acid, liberates electricity enough to charge a Leyden jar. Now the carbon entering into the constitution of vegetables cannot give less electricity than freely burning carbon; hence we may conclude, that upon a surface of vegetation of 100 square meters, (0.099 rood,) more negative electricity is produced in a day than would suffice to charge the strongest electric battery.

Buff took up the experiments of his predecessors, without putting platinum plates in direct contact with the organs of vegetables, and operating much as Dubois Reymond has done in his researches on animal electricity. In order to change as little as possible the natural conditions in which a plant is found, Buff employed water as the medium of communication between different parts of the plant and the galvanometer. He first compared the electric state of the leaves with that of the roots. He then examined branches separated from the vegetable; afterward the young and fresh bark, the buds, flowers, &c. He regards it as established by his experiments, "that the roots, and all the external parts of plants which are filled with the juices of vegetation, are negative relatively to the surface, more or less moist, of the leaves, the flowers, the fruits, and the young branches."

Buff thus explains this fact: "The interior of the plant contains juices of various natures, which cannot pass through the epidermis, while the exterior moisture always soaks a little into this membrane."

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* Journal Encyclopédique de Naples. Annales de Chimie et de Physique. 1807. Vol. lxii, p. 212.

† Poggendorff's Annalen der Chemie. Vol. lxxix.

‡ Annales de Chimie, etc., 1827. Vol. xxxv, pp. 414–420.

We have then in contact a membrane soaked with water, and vegetable organs charged with liquids of various natures. If, now, we establish between this membrane and these organs a closed circuit, a current must evidently be produced. "But it appears evident," adds Buff, "that this current has a relation, very indirect and remote, to the phenomena of vegetation."*

Becqurel reaches these conclusions:

1. Derived currents are produced in the stems of vegetables by platinum needles, one introduced into the bark, the other into the wood, directed from the *parenchyma* to the pith.

2. Similar currents are produced in the bark, proceeding from the *càmbium* to the *parenchyma*, directed inversely to the preceding.

3. The sap, or the liquid of the cortical parenchyma, if retained in contact with the air for a few seconds, suffers such a modification that on putting it anew in contact with sap found in the green part of the parenchyma of the bark it becomes negative to it.

4. Derived terrestrial currents are produced through the medium of the roots, of the pith, and of other parts of the stem.

5. The direction of the terrestrial currents shows that in the act of vegetation the earth constantly takes an excess of positive electricity, and the parenchyma of the bark and of the leaves an excess of negative electricity, which is transmitted to the air by the exhaled water.

6. The distribution of the ascending juices and of those of the cortical parenchyma warrants us in believing that currents circulate constantly in vegetables, directed from the bark to the pith, passing through the roots and the earth, or perhaps without passing through them.

7. Chemical actions are the primary causes (it cannot be doubted) of the electric effects observed in vegetables. These effects are varied, and up to the present time we have been able only to observe a small number of cases.

8. The opposite electric states of vegetables and the earth give rise to the thought that by reason of the power of vegetation upon continents and islands they must exert a certain influence upon the electric phenomena of the atmosphere.†

So Becqurel and Wartman‡ believe that closed currents constantly circulate in the interior of each plant, which are directed from the bark to the pith, and thence to the extreme branches; they attribute the production of these currents to the presence of two different liquids reacting chemically upon each other by the intervention of tissues that are scarcely permeable.

De la Rive remarks that "it seems demonstrated that hitherto we have no proof of an electric state in living vegetables analogous to that which we have found in the muscles and nerves of animals; and that all the traces of electricity that have been collected may be attributed to ordinary chemical reactions, and in some cases to atmospheric electricity. The phenomena of the osmotic force lately studied by Graham are not contrary to this conclusion, since it is to a chemical action that he attributes the production of the electricity that accompanies endosmosis."§

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* Liebig's Annalen der Chemie, etc. Vol. lxxxix, pp. 76–89; Annales de Chimie. 1854. Vol. xli, pp. 198–202; Journal de Pharmacie. 1854. Vol. xxv, pp. 154–157; Philosophical Magazine, 1854, vol. vii, pp. 122–126.

† Comptes Rendus de l'Académie des Sciences de Paris. 1850. Vol. xxxi, pp. 633–635; Annales de Chimie. 1851. Vol. xxxi, pp. 40–67.

‡ Bibliothèque Universelle de Genève. 1850. Vol. xv, pp. 301–305; Phil. Mag., Suppl., 1851, vol. i, pp. 578–581.

§ Treatise on Electricity. London. 1858. Vol. iii, pp. 83–88.

I shall close this chapter with a curious experiment made by Donné.* He found in apples and pears an electric current passing from the stem to the eye, making the stem end electro-negative and alkaline, while the end of the eye is electro-positive and acid. The peach, apricot, and plum present a reverse current. In the plane perpendicular to that which passes through the stem and the eye, the electric current ceases at equal distances from the center of the fruit. The juice of these fruits has the same electric properties. Donné thinks that these effects are not due to the acid and the alkaline quality of the fruit, but that all the juice of fruits is not of the same composition at the stem and the eye, and this is sufficiently heterogeneous to produce these electric currents. When an apple or pear is cut in two, the stem end will be found the sweeter, while in the peach or apricot the eye is the best.

ACTION OF ELECTRICITY† ON THE GERMINATION AND GROWTH OF PLANTS.

The earliest experiments on the influence which electricity may exercise on plants appear to have been made by Dr. Maimbray,‡ of Edinburgh, in the autumn of 1746. He electrified two myrtles, and found that they put forth small branches some inches in length, and even came into blossom during the month of October. This did not happen to myrtles not electrified, and he attributed the phenomenon to the influence of electricity. This experiment was repeated in Switzerland, France, Germany, and Italy.

In the preceding year, 1745, Boze§ had observed that water issuing from a vessel in minute drops would pour out in a continuous stream when the vessel was electrified. The cause of this phenomenon was investigated by l'Abbé Nollet,‖ who thought that this electrical effect in capillary glass tubes might have some connection with the sap in plants, and hence produce the unusual growth observed by Maimbray. His first experiments were made on fruits, green plants, and moist sponges, and he invariably found that evaporation had been hastened by the action of electricity. In October, 1747, he took two small wooden bowls, filled with the same kind of earth, sowed them with similar mustard seed, and found that after two days several of the seeds in the electrified bowl had come up, while no alteration had taken place in the other. The following day nine of the electrified seeds had come up—none of the non-electrified ones; and this superiority was kept up till the plants in the first bowl were ten inches high, and those in the second not more than a quarter of an inch.

In repeating this experiment, in different ways and with other seeds, the same results were always obtained. The electrified plants, however, appeared rather weaker than those which had not been so treated.

In the same year (1747) John Browning¶ read a paper before the Royal Society of London, on the effects of electricity on vegetables, in

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* Annales de Chimie. 1834. Vol. lxii, pp. 405–414; Annales des Sciences Naturelles Zoologie. 1834. Vol. i, p. 125.

† For want of space, I am obliged to defer all mention of adverse experiments, as well as the influence of atmospheric electricity and lightning on vegetables. I have mentioned only the principal authors who treat the subject of this chapter.

‡ In more than sixty authors consulted on this subject, I have found no mention of the original publication of the experiments of Maimbray.

§ Mémoires de l'Académie des Sciences de Paris, 1745, pp. 119–133.

‖ Mémoires de l'Académie des Sciences de Paris, 1748, pp. 172–175; Recherches sur l'Électricité. Paris, 1749. P. 342.

¶ Philosophical Transactions. 1747. Vol. xliv, part ii, pp. 373–'75.

which he describes his own experiments as well as those of Baker, who electrified a myrtle at the Duke of Montague's, in Ditton.

In the months of April and May, 1747, Jallabert* electrified various plants two hours every day regularly, exposing them to the open air after the operation, and found that all of them, and in particular a carnation, grew rapidly and flourished remarkably. In the autumn of 1747 he electrified bulbs of hyacinth, jonquil, and narcissus, which were beginning to grow in glasses of water. Those which were electrified grew more rapidly, the leaves were larger and the flowers opened sooner than those not electrified. He found that the electrified bulbs gave off more moisture in a given time than other plants. He also repeated the experiments of Nollet on mustard and cress, with similar results, and attributed these effects to an acceleration of the movement of the sap caused by electricity, analogous to that observed by Boze in capillary tubes.

Boze,† of Wittemberg, electrified, in 1747, different kinds of plants and shrubs, the growth of which invariably seemed to be accelerated. Similar results were obtained in 1748 by L'Abbé Menon,‡ of Angers, who, in a letter to Reaumur, states that, by the aid of electricity, he had greatly facilitated the growth of offsets of ranunculus, even in the depth of winter.

In 1752, J. Freke,§ in his curious treatise on the nature and properties of fire, quotes experiments with electricity on the leaves of the sensitive plant, the irritability of which was then considered by many of electrical origin.

In 1771, Nuneberg,|| of Stuttgard, took two boxes, each containing five bulbs in all respects alike, and electrified one of them; the plants grew far more rapidly than those in the other box, their relative size after eight days being as eight to five.

In the same year, Sigaud de la Fond,¶ of Montpellier, found the bulbs of hyacinths when electrified grew faster and formed more healthy plants than those not electrified.

In 1776, L'Abbé Bertholon** made some experiments on the conducting power of plants for electricity, in which he showed the great difference which exists between different plants, those, generally speaking, being the best conductors which were the most succulent or contained the largest quantity of moisture.

The announcement was made, in 1775, by C. H. Koestlin,†† that negative electricity was detrimental to vegetation, both animal and vegetable life being retarded by it. This appears to be the first distinct observation as to the different influences of positive and negative electricity, for the preceding experiments seem to have been made with positive electricity alone.

According to Gasc‡‡, Linnæus proved the influence of electricity on plants. In 1779, a naturalist §§ in London determined to repeat the origi-

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* Expériences sur l'Électricité. Genève, 1748. 8vo., p. 93.

† Comment. novus de Electric. 10.

‡ Mémoire de l'Académie des Sciences de Paris.

§ Treatise on the Nature and Properties of Fire. 1752.

|| Rapport à la Société Physique et Économique de Stutgard. Introduction au Journal de Physique. 1771. Vol. i, p. 436.

¶ Précis Historique d'Électricité. Paris, 1781. P. 414; Traité d'Électricité. Paris, 1771. P. 374.

** Journal de Physique. 1789. Vol. xxxv, pp. 401–423.

†† Dissertation physica experimentalis de effectibus electricitatis in quædam corpora organica. 1775.

‡‡ Mémoire de la Société Linnéene de Paris. 1823. Vol ii, p. 54.

§§ L'Abbé Bertholon, La Nature considerée sous ses différents rapports, Paris. 1780. P. 89.

nal experiment of Dr. Maimbray, and accordingly electrified a myrtle for many hours a day for some time in the middle of December. The result was that the tree formed buds and threw out small branches in a remarkable manner.

In 1781, Count de Lacépède* describes some experiments which he had made on vegetables, observing that invariably in electrifying a plant he found it grow or increase with more vigor than usual, and that the germination of seeds and sprouting of bulbs placed in water was always hastened in a very decided manner by electricity.

Dr. Marat† described in 1782 some experiments he had made on the germination of electrified seeds, from which he draws the conclusion that it exerts powerful influence on the fertility of the soil. On the seventh day the plants began to make their appearance in the electrified vessels, and at the end of a fortnight they were as forward as similar plants sown on the same day, but kept in a room nine degrees above the freezing point. In the three vessels which were not electrified the seeds had not begun to germinate.

In 1783, L'Abbé Bertholon‡ published the first book on electricity applied to vegetables, after making numerous experiments. The results of Nollet and Jallabert were confirmed by Bertholon. He observed that interrupted electrification appeared to have more influence than when continued, in accelerating vegetation. He gives some curious facts on the colors, odors, and taste of fruit and flowers, on the development of which he thinks that electricity exerts a very remarkable influence. Fruits nearly ripe, on being electrified, were found to acquire the odor and taste of ripeness sooner than others not electrified. Flowers or plants just coming into blossom arrived sooner at perfection, and the colors were more brilliant than is ordinarily the case. When plants in flower were electrified, the blossoms were observed to become more brilliant in color, and of a richer and more delicate tint, than other flowers of the same kind. All these experiments were made with positive electricity, but with negative electricity the effects for the most part were reversed; germination was retarded, the growth and formation of the leaves were checked, the development of fruit and flowers, and the secretion of coloring and odorous matters was impeded. He states that these effects may be observed by experiments on a small scale, as well as by carefully watching the electric condition of the atmosphere on a large scale.

Bertholon attributes the increase and development of certain insects which feed on plants to the agency of electricity, which he says exerts the same influence upon them as on the seeds of plants. He accordingly proposes to kill them by an excess of electricity, passing the shocks of Leyden jars through the trunks of trees on which the larvæ of insects are deposited, and provided the shock is not too powerful the tree will not be injured. All the ordinary diseases to which plants are subject may, he thinks, be diminished, counteracted, or entirely cured by a judicious use of electricity.

In 1784, Achard published his observations, in several essays, on the electricity of rain, snow, and hail, on electrifying fluids, on germination, and the influence of electricity on the growth of vegetables, in which he confirms the results of preceding philosophers; also, on the influence of electricity in promoting the fermentation and putrefaction of vegetable and animal matters. He found that both negative and positive electricity

* Essai sur l'Électricité Naturelle et Artificielle. Paris, 1781. Vol. ii, pp. 159.
† Recherches Physiques sur l'Électricité. Paris, 1782. P. 359.
‡ De l'Électricité des Végétaux, &c. Paris, 1783. 8vo., 468 pp. and 3 pl.

accelerated the putrefaction of animal matter, causing barley and other fermentable substances to pass into spirit with increased rapidity.*

From 1786 to 1790 Perzieret† made numerous experiments on chervil, wheat, beans, rye, peas, mustard, radish, lettuce, trefoil, &c., and in nearly all cases the electrified plants came up first, grew larger, and had longer roots than the others; the leaves were more numerous, larger, and of a decidedly more beautiful green.

In 1788, Carmoy‡ described a variety of experiments on the germination of wheat taken from the same ear. After twenty-three days the young plants were measured, when it was found that the unelectrified had grown eleven inches ten lines, the positive eighteen inches five lines, and the negative nineteen inches nine lines. A number of other experiments of the same kind are given, the general result of which is that electricity appears to accelerate germination, negative electricity being more powerful than positive.

In 1789, L'Abbé d'Ormoy§ electrified mustard seed and lettuce for several days in moist earth, and found their germination always accelerated. He found also that electrified seeds had always the start of the non-electrified, and so beneficial did he find it to germination that even old and dry seeds, which seemed spoiled and would not germinate, did so rapidly when previously electrified for some hours.

Almost the same results were published by Bertholon at nearly the same time. He inclosed parcels of seeds in tin-foil, and kept them constantly electrified for some days before sowing, when he found that they germinated remarkably soon. These experiments were made with seeds of spinach, endive, and turnip. He describes experiments in which he found seeds to germinate sooner when placed on the plate of a charged electrophorus.‖

At the end of the last century, the discovery of voltaic electricity, and the brilliant results to which it led, completely eclipsed the hitherto favorite study of frictional electricity. Boziéres, one of the first, entered this new field of investigation by two papers containing numerous experiments made from 1786 to 1790, in chervil, wheat, beans, rye, peas, mustard, radish, lettuce, trefoil, &c., the result of which was that, in nearly all cases, the electrified plants came up first, grew larger, and had longer roots than the others. The leaves were more numerous, larger, and more beautifully green.¶ These researches confirm the original experiments of Nollet and Jallabert, and prove that the views of Ingenhousz were incorrect, and the effects in question were not results of imperfect experiments, due to the unequal influence of light, but were really caused by electricity. In this view Boziéres was borne out by the experiments of Bilsborrow in 1797, who found germination decidedly accelerated by positive electricity, and still more by negative.

In 1807, Sir Humphry Davy published some interesting experiments on seeds and growing vegetables. Seeds placed in pure water at the positive pole of a voltaic circuit germinated much more rapidly than under ordinary circumstances, but at the negative pole they did not sprout at all. He remarks that without supposing any peculiar effects from the different electricities, this may be accounted for by the saturation of

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*Memoiren der Berliner Academie. 1783. Physicalische und Chemische Abhandlungen. Berlin. 1784. Vol. i, p. 784. Journal de Physique. 1784. Vol. xxv, pp. 434–436.

†Journal de Physique. 1791. Vol. xxxviii, pp. 351–365, 427–446.

‡Journal de Physique. 1788. Vol. xxxiii, pp. 339–343.

§Journal de Physique. 1789. Vol. xxxv, pp. 161–176. Annals of Agriculture, by Arthur Young. London, 1791. Vol. xv, pp. 28–60.

‖Journal de Physique. 1789. Vol. xxxv, pp. 401–423.

¶Journal de Physique. 1791. Vol. xxxviii, pp. 351–365, 427–446.

the water near the positive metallic surface with oxygen, and that near the negative pole with hydrogen, though he does not think it impossible that the same effect may be due to electricity. When growing plants were made the medium between the two poles of the battery, in one case a mint-plant was killed, but another, after ten minutes, remained uninjured. Lime and fixed alkali were found at the negative pole, while chlorine and sulphuric acid were at the positive pole of the battery.*

These experiments were held by Du Petit Thouars as evidence of the great influence of electricity on vegetation. He held that plants contained two different galvanic arrangements—one acting vertically through the woody fibers, the other horizontally, through the medullary rays. To these opposite independent currents he attributed the principal phenomena of vegetation.†

Many experiments on the influence of electricity of low tension on germination have been made by Becquerel‡ since 1833. Seeds in contact with the upper element of a feeble galvanic current grew faster, while those in contact with the zinc element grew less rapidly than similar seeds planted in glass; the negative extremity increasing, the positive retarding germination. Similar results were obtained with bulbs connected in water. The favorable influence of negative electricity of low tension on germination is attributed to the decomposition of saline substances, and consequent evolution of alkaline matter, which assists germination by combining with and neutralizing the acetic acid always evolved during germination and the growth of bulbs and buds.

In 1825, Pouillet§ proved that in germination, a notable quantity of electricity is disengaged. Setting aside all consideration of the more complicated changes of germination, we may call it a mere oxidation, the whole effect of the air on sprouting seeds being the abstraction of carbon and formation of carbonic acid gas; a change analogous to the combustion of carbon, and which, like that, would give rise to electricity. Pouillet's experiments, though delicate, are very simple: twelve glass capsules nine inches in diameter, well varnished with lac, having seeds in them, were placed in two rows on a table covered with the same varnish, and filled with vegetables and connected by wires with each other, and the one plate of a condenser. For the first two days, no signs of electricity were given by the gold leaf electrometer of the condenser, but on the third, when the plants appeared, negative electricity was indicated, and continued night and day for over a week. It is evident, from the experiment, says Solly,‖ that electricity being set free in germination, the seed becomes negative, while the carbonic acid given off is, of course, positive—a very important conclusion, if established, both in respect to the source of atmospheric electricity, and as to the influence of electricity on germination. It is suggested that as all vegetable soils contain carbonaceous matter, which is continually undergoing oxidation, carbonic acid is constantly formed in the soil just as it is in the sprouting of seeds.

In the spring of 1843, great interest was aroused by the statement of a discovery by which atmospheric electricity was collected so as to increase vegetation extraordinarily. This originated with Dr. Forster,¶

* Philosophical Transactions. 1807. Part I, p. 1; Elements Agricultural Chemistry. London, p. 37.

† Essais sur la Végétation. Paris, 1809. IX Essay.

‡ Annales de Chimie. 1833. Vol. li, pp. 252–260. Traité Expérimental de l'Éctricité et du Magnétism. Paris, 1834. Vol. i, pp. 61–64, 135, 377, 301–2; vol. iv, pp. 159–210. Traité d'électricité et de Magnetism. Paris, 1855. Vol. i, pp. 366–371.

§ Annales de Chimie. 1827. Vol. xxxv, pp. 414–420.

‖ Journal of the Horticultural Society of London. 1846. Vol. i, p. 97.

¶ Agricultural Gazette, 1844, p. 741; 1845, p. 249.

of Elgin, who, after stretching wires in particular directions over a crop of barley, saw most luxuriant vegetation produced.*

About the same time, accounts of American experiments were circulated, showing that equally extraordinary effects were produced by feeble currents of voltaic electricity on vegetation. In July, 1844, W. Ross stated to the Farmer's Club, of New York, that, having planted potatoes in drills, he buried at one end of these rows a copper plate, five feet long and fourteen inches deep, connected by a wire with a zinc plate, the same size, buried two hundred feet away, at the other end of the rows. On the 2d of July, some of these potatoes were found two and a half inches in diameter, while the rows on either side, not under electric influence, had not formed tubers of more than half an inch in diameter.† This statement, like that of Dr. Forster, excited great interest. Many repetitions of his experiments were made in various parts of England; among others, by Jessop, on the estate of the Duke of Devonshire.

It was also said that electro-culture produced thirteen measures of barley on a surface which by the common mode yielded but five.‡ Walker also published some experiments on electro-culture.§

ANDRÉ POËY.

Hon. HORACE CAPRON, *Commissioner.*

REPORT OF THE EDITOR.

SIR: The organic act creating the Department of Agriculture makes it the duty of the Commissioner to acquire "all information concerning agriculture which he can obtain by means of books and correspondence, and by practical and scientific experiments, by the collection of statistics, and by any other appropriate means in his power;" and also requires him to make periodical and special reports including such acquisitions. It is thus not merely a Department of administration and routine, but also one of investigation and experiment, which should be truly scientific and entirely accurate, and always eminently practical and utilitarian. Its warrant for agricultural research is thus sufficiently broad to cover any field of investigation which promises results favorable to production, rural improvement, and farm economy. Yet, the magnitude of the country, the variety of its industries, and the urgency of new and important problems pressing for solution, counsel adherence to a line of research that shall be progressive, timely, effective, reaching forward toward new developments and fresh discoveries, rather than groping among the records of the dead past for that which our fathers practiced and pondered upon. In a field of experiment that is continental, with climates of all latitudes and elevations, and with investigators of tastes and necessities of the widest range, the work of this office should be well chosen, limited to whatever is most vital and important, and conducted vigorously with all the means and facilities at command, with reference to present results, in co-operation with minor organized agencies, and with the great mass of active and progressive agriculturists of the nation.

* See the account of Gordon at the Tring Agricultural Association in 1844, in the ournal of the Agricultural Society of London, 1846. Vol. i, p. 99.

† Mechanic's Magazine, September 28, 1844; the Electrical Magazine. London, 1845. Vol. i, pp. 610–611.

‡ Gazette d'Agriculture, May 31, 1846.

§ Archives de l'Électricité. Genève, vol. v, p. 525.

A branch of this work which cannot be ignored is the collection of fresh facts illustrating the comparative economy of rural processes and industries, and the record of experiments tending to elucidate disputed points in farm practice. Scientific farmers, agricultural societies, industrial colleges, and the Department of Agriculture, furnish every year new material for such a record; and the attempt to present approximate estimates of the current crop productions of the country opens a constantly widening field of labor.

The scientific sections of this work, embracing agricultural chemistry, botany, entomology, and other branches of natural history, to which farmers are looking for advances upon the discoveries of Liebig, practical instruction upon the flora of America and of the world, and the means of saving millions now given up to insect depredations, have facilities for efficient and valuable labor, the results of which, given to the public in these reports, it is hoped will year by year prove of increasing interest and value.

In accordance with these views and aims, so far as developed and wrought out with yet imperfect facilities, the accompanying articles are presented. They are not merely the work of one man, or of several working in official cloisters, but the embodiment of the freshest views of thousands in communication with the Department—among them those recognized as foremost in knowledge and practice of some specialty or interest—and as such worth far more than the essay of a single individual, with its limited field of observation, a tendency to display of personal egotism, a habit of bestriding a favorite hobby, and too often a pecuniary axe to sharpen. Besides, the essay in our former experience has been almost invariably, and generally from necessity, a retrospect, a mere compilation, a new use of old material; it usually adds little to the stock of facts and experiences of practical agriculture. Such reiteration is useful and necessary in a newspaper; it should not be the staple and substance of an official report. While original facts and results should mainly constitute the matter of official publications, there are subjects of present interest, not new in themselves but freshly and urgently pressing themselves upon public attention, which should be examined retrospectively, but with constant reference to their points of immediate value and practical bearing upon industry and production. In this connection reference may be made to articles relative to tea culture, American sumac, the opium poppy, the cranberry interest, the results of steam-plow invention and steam culture, and the sugar-beet enterprise. Prominent among the subjects presenting the facts and progressive indications of the year, are those collating recent farm experiments, classifying new agricultural patents, distilling the spirit of the State reports of agriculture, recording the current history of industrial colleges, compiling recent laws concerning farm stock, mapping out the location of mineral fertilizers of the Mississippi Valley, and pointing out the resources of the great mountain section of the continent. These and similar presentations will illustrate, though they may fail fully to realize, the aim and object of the miscellaneous portions of the annual report of agriculture. If future observations continue to be conducted in this spirit, the ultimate results will be valuable and instructive in a high and cumulative degree.

J. R. DODGE,
Editor of Reports.

Hon. HORACE CAPRON, *Commissioner.*

LANDSCAPE GARDENING.

Landscape gardening is a comprehensive art, combining the genius of the landscape painter with the art of the practical gardener; the exact knowledge of the engineer with the poetical imagination of the artist. The professor of this art should also possess a competent knowledge of the general principles of botany, architecture, geology, hydraulics, hydrostatics, mechanics, laws of heat and ventilation, pomology, and vegetable physiology. This may seem rather a formidable array of acquirements, but in the multifarious details of selecting and arranging the style and location of rural residences and their accompanying domestic auxiliary structures; the drainage of lands; the location and construction of roads; the preparation of garden sites, and the erection of horticultural buildings; the decoration of grounds for the purposes of beautifying and enriching the surroundings of rural homesteads, the more ambitious suburban villas, and public buildings of every description; and the artistic disposition of arborescent growths, so as to produce the most varied yet distinct beauties of which the scenery is susceptible—necessitate a knowledge more or less intimate and extensive with these, as well as with other branches of science.

During the last twenty years much attention has been given to landscape gardening, both in the laying out of private grounds and in the design and construction of public parks. Some of the latter are deserving of the highest commendation, both in design and execution, and have been the means of instructing and familiarizing the public with the capabilities and beauties of the art, and in educating the popular taste to an appreciation of the development of rural improvements, and their beneficial effects upon the moral and physical condition of society.

It cannot be too forcibly urged upon the attention of those who are intrusted with educational institutions that one of the most certain means of encouraging a desire for studies in natural history, and forming correct principles of taste in young minds, is that of landscape embellishment of school-house and college grounds. This has become one of the greatest wants in existing systems of education, and cannot long remain neglected.

It is not proposed to offer a treatise on landscape gardening, but rather to allude briefly to some of the more prominent points and subjects that will naturally arise for consideration in the location of residences and public buildings, and in the arrangement of the principal accessories, and the execution of various details connected with rural improvements.

GARDENING AND CIVILIZATION.

Gardens are of the most remote antiquity. Our first parents were placed in a garden, and the writings of the oldest historians and poets contain various descriptions and traditions concerning the extraordinary beauty of the gardens. History proves that a taste for gardening has kept pace with the progress of civilization, and that it has always exerted a powerful influence upon the passions and feelings of mankind. Much of the decorative beauty of architecture has resulted from the study of the beautiful combinations and graceful lines of the vegetable kingdom. Two thousand years before the Christian era Lydia was famed for its gardens. The gardens of Babylon are traditionally ranked among the greatest successful combinations of skill and wealth. The Persian kings were very partial to gardens, which were cultivated as much for

their beauty as for their fruit, and even in gardens of limited extent the trees were arranged in regular lines and figures, and the walks bordered with tufts of roses, violets, and other odoriferous plants. The Greeks copied from the Persians, both in their gardening and their architecture. Epicurus took great delight in his garden, and there taught his philosophy. The Greeks excelled in architecture more than in gardening, although a public park or garden was planted by Cimon, the general, at Athens, furnished with streams of water and planted with shady groves, with gymnasia and places for exercise. They had flower markets which were well patronized, and learned or distinguished men wore crowns of flowers, and successful warriors were decorated with wreaths and garlands. Their garden decorations partook largely of statuary and other architectural appendages.

The Romans devoted much of their wealth to the adornment of their gardens and pleasure parks. Lucullus seems to have had large ideas of magnificent expenditures in this direction, being represented as having sumptuous villas in different parts of Italy, so that he could enjoy an agreeable climate every month in the year. Cicero had fine plantations at his Arpinum villa. Sallust, who made a fortune in the government of Numidia, devoted largely of his means to the laying out of gardens, which were for a long period the pride of Rome. Pliny's villa appears to have been laid out with more taste and less of ostentatious display than some others, since the pastoral beauty of his grounds are highly praised. It is apparent, however, that the principal features of ornamentation were derived from vases, fountains, and similar works of art that bore the semblance of wealth, and were at once objects that conveyed impressions of grandeur and magnificence, rather than to wait patiently for effects to be produced by artificial plantations, which required time for their development, and a higher appreciative taste for their enjoyment.

The Romans also devoted much attention to culinary vegetation, and carried their knowledge of science and the arts into such countries as they colonized, so that a great degree of wealth and enlightened prosperity accompanied their footsteps to an extent that the world has rarely seen equaled.

With the reign of the emperors commenced the decline of the empire. The reign of barbarism was triumphant, and the finest palaces, country houses, and gardens were destroyed. For five centuries the monks were almost the only class who cultivated gardens, and kept alive the culture of fruits, vegetables, flowers, and medicinal herbs during the dark ages. To them we are indebted for preserving and handing down the arts of gardening and architecture.

It was not until the middle of the fifteenth century that the arts of peace and commerce were so prosperous as to awaken a love for the fine arts; and the examples of former grandeur that still remained, together with traditions of ancient magnificence, stirred up a desire of imitation, and Italian gardening attained a perfection and standing that are still recognized and distinguished among rural improvements.

STYLES OF LANDSCAPE GARDENING.

There are two very distinct modes of laying out grounds, known as the geometrical and the natural. Various terms have been used from time to time by descriptive writers on these subjects to designate styles, but they are all easily referred to one or the other of these modes. Under the *geometrical* may be placed the formal, Roman, architectural, and

ancient, as well as the Italian, French, and Dutch varieties of this style. Under the *natural* we may, in a similar manner, place the gardenesque, modern, irregular, English, and graceful.

A third style is commonly included, but has never been very successfully defined, either practically or hypothetically, that is the picturesque. The former two are sufficiently comprehensive for the present purpose.

THE GEOMETRICAL STYLE.

In the earlier ages of the world the possessor of wealth exhibited his riches by surrounding his residence with such improvements as were most distinctive from the common scenery of the country. Hence gardens were ornamented with ballustraded terraces of massive masonry, magnificent flights of steps, elaborately decorated arcades, costly fountains, architectural grottoes, and lofty clipped hedges arranged with niches and recesses for the display of statuary. His less wealthy neighbor contented himself by substituting a sloped grass bank for the stone terrace, shaped his small lake in a square or circular form, and clipped his trees and shrubs into fantastic shapes, aiming at ostentation without regard either to propriety or good taste.

Such a style is well fitted for immediately producing startling, if not grand effects; and during early stages of society, and in countries abounding with the irregular and natural forms of uncultivated scenery, distinction is at once imparted by introducing perfectly level, or regularly sloping surfaces of ground, trees planted at uniform distances apart, and lakes or ponds bounded by geometrical lines, so as to leave no chance of mistaking any portion of the scene as having been the result of unassisted natural arrangement, but unmistakably to convey the impression of a display of wealth and refinement, and to indicate ownership by distinguishing the country residence from the natural, uninclosed, rude scenery of the neighborhood.

In the strictly geometrical style everything is architecturally accurate in its lines, perfect symmetry pervades the whole, and all parts are equally balanced. Statuary of all kinds, fountains, steps, ballusters, and pediments, broad walks, straight planted avenues, formal shaped flower beds, and clipped plants, all belong to this species of garden and landscape decoration.

THE NATURAL STYLE.

In the geometrical style the hand of the artist is evident in every detail; but in the natural style artificial interference is not so conspicuously apparent. In the disposition of the material used for the development of landscape views and scenic effects, there is nothing, so far as general impressions are concerned, to indicate where the hand of the improver has been operating, or anything appearing beyond a natural production, or what may have been indigenous to the locality. All natural beauties are carefully preserved, so far as is consistent with objects of use or convenience, and the element of utility enters more largely, perhaps, into our ideas of the beautiful in this than in the geometrical style; and, while there is no desire to avoid the appearance of art in operative details, it is not rendered obtrusive, and the effects produced need not suggest the idea of painful and laborious operations.

The perception of the beautiful ought to be the first impression, and not that of the art by which it has been produced. The beauties of nature are imitated in the disposition of trees and shrubs, and, so far as

general scenic effect is concerned, the arrangement might be taken for a natural group; yet a closer examination of details will lead to the discovery that the plants employed are not indigenous to the locality, and thus art and design will be recognized. So also in a district where evergreen trees do not exist in the surrounding natural woods, their introduction in the scenery will at once convey the impression of an artificial plantation, so far as regards the materials of which it is composed. While, therefore, the general effects produced in this style are similar to those with which we are familiar in natural scenery, the details are dictated by convenience, utility, and adaptability to the end in view.

A neglected foot-path, seen in the distance, curving gracefully around the sides of a hill, or on the banks of a stream, now embracing a thicket of trees and undergrowth, and lost in a maze of tangled vines, then emerging and tracing its course across the meadow, alternately widening and narrowing, and at times altogether lost in the massive foliage of grasses and other natural growths, is what might truly be termed a natural path. Let it be trimmed and widened, however, its surface neatly adjusted and covered with gravel, its curves well defined, and its sides made perfectly parallel, and it will have lost much of its beauty as a natural woodland path, although the contiguous scenery has not been disturbed, nor in any degree impaired. It is now invested with the beauty of utility, and, however much we may have admired it in its original condition, yet for comfort, as a dry and convenient walk, we greatly prefer its improved condition; and, in addition to the charms associated with its position, it has those of adaptability and fitness to the end in view.

CHOOSING A LOCATION FOR BUILDINGS AND GROUNDS.

In choosing a location, one of the first considerations is that of access to and egress from a city, and if daily intercourse is contemplated, it becomes a question of special interest. The time, trouble, and expense of travel on bad roads are a severe tax upon country pleasures. A drive of half an hour on a hard road, during a fine summer evening, is a recreative pleasure which may not be appreciated when an hour and a half are spent on the same distance during a stormy winter morning. A good road in dry weather may become very indifferent after rains, and be impassable for three-fourths of the year.

In these days of railroads and steamboats it is difficult to indicate what might be considered a convenient distance from a city. Upon a well managed railroad a distance of twenty miles may be more accessible than two miles upon a common road. Proximity to a railroad station will always secure a certainty of convenient transit, even allowing the distance to be within an easy carriage drive. This facility should not be overlooked when it can be secured.

Healthiness of locality is of paramount importance. Low, flat lands are generally damp and cold, and should never be selected for the habitation either of man or beast, if there is any choice in the matter. Valleys, or even slight depressions, are equally unsuitable. The air after sunset is always dense in such places, dews are heavier and more frequent; and, as a consequence, frosts are more prevalent than on elevations. Fogs are most frequent on low lands. The extremes of temperature are also greater, especially if surrounded by forests, which prevent the free circulation and equalizing influence of winds. Wide and long valleys between uniform hills are frequently subjected to sweeping blasts. Even the vicinity of such localities ought to be avoided. A person

may drain, cultivate, plant, and otherwise improve his own property, and still be subjected to the injurious influences of unimproved lands over which he has no control.

An elevated situation is generally healthy. The extent of prospect it secures is also an advantage; yet it is not well to place too great a value on distant views. For permanent residence the exposure of elevations is a disadvantage. Though cool, airy, and agreeable in summer, they may be bleak, chilly, and exceedingly uncomfortable during winter. The tender and delicate varieties of flowers and shrubbery, as well as fruits and culinary products, are less likely to flourish when fully exposed to cold and unbroken winds.

SELECTING A BUILDING SITE.

This is too commonly settled by selecting the highest point of the ground, but not always wisely. A modern house set up on a sharp knoll has an isolated appearance which is not readily altered or improved by trees, and it is with difficulty approached by roads, if the grounds slope suddenly from it.

A somewhat level plateau, partially surrounded by higher ground, forms a good position for a dwelling-house. The ground should fall from it in all directions, more rapidly in front than back, where the descent may be merely sufficient for drainage. Back of the house, positions should be selected for the vegetable garden, stables, and other buildings, such as greenhouses and graperies, all of which will be sheltered and protected by the higher ground beyond.

The nature of the soil should receive attention in selecting a spot for a house. Clay soils are retentive of water; and, even when artificially drained, the surface is disagreeable after rains. Clay, in contact with foundation walls, keeps them damp and cold. The expansion of clay when wet, and shrinkage when dry, unfit it for a safe foundation. If every other condition is secured in a site, art can do much toward ameliorating the physical qualities of the soil; but, for all the purposes of human comfort and enjoyment, in the immediate vicinity of a house, a light, open, porous soil is decidedly the best.

It is always desirable to secure the beauty and utility of a natural plantation; but, to select a site for a mansion in the center of a grove of old trees, with the intention of making them a nucleus for future landscape effect, will generally prove unsatisfactory. In natural forests the trees grow closely together; their trunks are long, slender, and destitute of branches; and, if thinning is attempted, those that are left seldom flourish for any length of time. If the thinning out is gradual, and the best of the remaining trees are judiciously pruned, they may ultimately recover, and make a satisfactory appearance.

Where old trees abound, it is difficult to prepare or keep a good lawn, or to introduce new shrubs or flowers. The roots of the trees prevent thorough renovation of the soil, and the shade of their branches interferes with the growth of plants. There is a steady antagonism between the old and the new, both with regard to individual growth and landscape effect, until either the one or the other predominates. It is no matter of doubt or uncertainty, but a settled question with all who have any experience in remodeling or adapting old woods or groves to modern improvements, that it is immeasurably better to commence on a treeless naked field; as a judicious selection and intermixture of fast-growing trees, properly planted in good soil, will, in a very few years, serve all useful purposes, produce such effects as are contemplated, and give

far more satisfaction than can be derived from the accidental position and growth of natural forests, at least so far as relates to improvements in the immediate vicinity of a rural residence.

PLAN OF IMPROVEMENTS.

The grounds being secured and the site fixed upon for the house, the next step is to prepare a well-defined working plan of contemplated improvements, and this is of equal importance whether the grounds are extensive or quite limited. To strike out the rude and simple outlines of an arrangement for the various accessories and conveniences of a country residence requires a mind thoroughly imbued with the principles of taste, and conversant with the application of art to the development of beauty; and, although we admit that every individual best knows what will meet his ideas of comfort and convenience in the abstract, there are few who can execute all the details, or satisfactorily introduce and fit all the disjointed parts so as to produce a complete whole.

As it is wisdom on the part of those who are about building a house to enlist the services of a competent architect, so it is essential to consult with a landscape artist in the preparation of a plan for the improvement of the grounds; as to what trees to plant and where to plant them; the proper introduction and construction of roads and walks; locating and erecting barns, stables, glass houses, and other buildings; selecting and preparing the soil for vegetable and fruit gardens; making lawns, and the numerous details that are involved in perfecting all the indispensable, useful, and ornamental adjuncts to a suburban house and grounds.

All plans should be as definite and simple as possible, and not overloaded with mechanical embellishments, as an excess in this respect generally indicates a deficiency in more important particulars. They should be accompanied with ample references, where each tree and the most important shrubs should be distinctly named, and referred to numbers on the plan. Intelligible reasons should be given for everything proposed, both with reference to immediate and to future effect, with clear instructions and suggestions with regard to the operations proposed, and the relative order in which they should be conducted. It may be taken as a rule, that no proprietor should undertake improvements until he sees clearly the objects and intentions of the design or plan; and, if this information cannot be conveyed by inspection and explanation, it is strong presumptive evidence of defect either in the design, or in the explanation, or in both.

In transferring designs to the ground, the most correct and speedy method is to divide the plan into squares, by lines drawn on it in both directions, the side of the square being of any length that will best subserve the purposes of accuracy. Squares of sixty feet for the sides will be found a convenient length; but in intricate designs, such as those for flower gardens, squares of thirty feet, or even shorter, may be necessary. The ground, or space to be operated upon, is to be divided into squares of the same size, and a stake set firmly at each point of intersection of the lines, and numbered to correspond with the numbers on the plan. A still more distinctive method is to use numbers for one direction and letters for the other; each stake will then be marked with a number and a letter. The plan and ground being thus prepared, the placing of a tree, or the laying down of a walk, or any other object, can be executed with the greatest facility. It also enables the work to be commenced at any point, and a short practice will enable any one, by

looking at its position in the square on the plan, to place a tree in its relative position in the square on the ground, without having recourse to exact measurements. A plan carefully prepared with references, and accurate as to scale, may thus be transferred to the ground by any person capable of reading letters and figures.

ARRANGEMENT OF OUTBUILDINGS, STABLES, ETC.

The selection of sites for the various buildings required near a country or suburban residence, is second in importance only to the selection of a site for the mansion. Convenience dictates that these buildings should be as near the house as is practically consistent with their objects and character. The dwelling-house will, of course, occupy the best and most advantageous position, and its superior size and style of architecture will always be such as to render all other necessary structures of secondary and subordinate appearance. Such buildings as stables and ice-houses are so obviously necessary to domestic comfort that their presence is not only expected, but their absence conveys an impression of poverty or incompleteness altogether inconsistent with our ideas of what a country home should be.

Instead, therefore, of endeavoring to entirely conceal these offices by plantations and by other expedients, as is frequently advised, they should be located on the most eligible sites, and display, in their architectural details and ornaments, an expression of the purposes for which they are intended, and be judiciously exposed to view without rendering conspicuous the operations necessarily connected with the structure.

The best location for these buildings will be governed, to some extent, by local circumstances; but, where there are no grades, views, or other exceptional features to interfere with the selection, a point in a north-east direction from the house will combine the greatest number of advantages.

While the stables and other farm buildings should not be entirely hidden from view at certain points, at the same time it will be obvious that a due amount of privacy in and about the buildings themselves, as well as in the line of view from the dwelling-house, will be essential, and can readily be effected by the introduction of trees and shrubs at the points indicated.

LAYING OUT ROADS AND WALKS.

The guiding principle in designing the position of roads and walks is utility. Nature forms no roads. They are the works of men and animals, and would undoubtedly always proceed in straight lines from point to point, if obstructions of various kinds did not interfere and cause deviations. Necessity will therefore suggest where and how they should be introduced. So far as regards approaches and walks to and from buildings, the object of their introduction is sufficiently apparent; but, in laying out pleasure grounds and lawn fronts, it is a common practice to introduce walks for the mere purpose of variety. This is a very questionable reason at the best, and not always successfully accomplished; but even in cases of this kind, they should appear to aim for some definite object, or lead to points of sufficient importance to suggest their utility.

Unnecessary roads and walks should be carefully avoided. They are expensive in their construction, if properly made, and require constant attention to keep them clean and in repair. Nothing looks so woebegone and poverty-stricken as a weedy, neglected road to a house, or walks

through pleasure-grounds or garden. They detract much from the beauty of the surroundings, no matter how elaborate or intrinsically worthy they may be. An over-supply of roads and walks is always a serious infliction.

The beauty of curved lines sometimes prompts to a deviation from the more available direct course; and, where it can be done without too great sacrifice of utility, it is not objectionable. But no walk should be turned from its obvious direct course without an apparently sufficient reason. A change of level in the ground, a tree, or a group of plants, or other similar obstruction, will induce, and seemingly demand, a change of line.

There are many locations where the straight line should be preferred as a matter of taste in design. As a connecting link between the strictly horizontal and the perpendicular lines of a building, and the irregular surfaces surrounding it, a perfectly straight walk is in the best taste and adds greatly to the effect of the architecture, while a frequently curving walk detracts from it. So also a walk along the side of a straight boundary fence should not curve if both lines are visible at the same time. Most persons are aware of the great beauty of straight walks and avenues of trees; and for public parks of lesser order, inclosed by formal outlines, they can always be introduced with great effect, as well as convenience, where curving walks would be the reverse. In this case beauty depends upon harmony rather than contrast, and more than either upon utility.

When roads or walks are carried over irregular surfaces, the natural turns and windings necessary to follow an easy or uniform grade, and keep as near the original surface of the ground as possible, will usually develop pleasing curves. A little studied attention in this matter of the course of a road will not only increase the beauty of curves by adding to them the grace of utility, but also deep and expensive cuttings, as well as heavy embankments, will be avoided, and easy grades and economical construction be more certainly secured.

When it is necessary to branch a secondary road from the main line, it should leave the latter at as nearly a right angle as convenient, and at the same time be somewhat narrower, so that its appearance may convey the proper idea of its being subordinate, and so avoid confusion and mistake; otherwise the roads leading to the stable, ice house, or garden, may be mistaken for the road to the mansion. Under no circumstances should walks be made conspicuous in views of natural scenery. If it is essentially necessary that a walk should cross a lawn where it would interrupt a continuity of view, and destroy breadth of effect, it should be sunk beneath the line of vision, by placing it in a slight excavation, which may be further assisted by throwing up a small mound on the side nearest the point of view. These expedients, as also that of planting thick groups of low-growing shrubs, will be effective and satisfactory if properly executed.

In laying out curving roads it is not advisable to closely follow geometrical rules, or to set the curves out to any regular radius. This plan may occasionally prove perfectly satisfactory on a strictly level surface, but it will have quite an opposite effect where the ground is greatly undulating. The curves, to be pleasing, must be "eye-sweet"—not too sudden or abrupt—and properly blended at their points of junctions.

CONSTRUCTION OF ROADS AND WALKS.

Very much of personal comfort and pleasure in rural residences depends upon good roads. A smooth, firm, dry road is one of the greatest

conveniences and enjoyments; while a rough, soft, muddy road is one of the greatest drawbacks and annoyances of country life. Bad roads form the greatest obstacles to progress and permanent improvements in all the neighborhoods that are blasted with their presence; they have a demoralizing effect upon the inhabitants, and are a sure sign either of poverty or mismanagement, or both.

Water is the worst enemy to good roads. It is, therefore, a leading principle in road-making so to construct them that they may be kept dry. In absence of a timely recognition of this principle, many costly roads have proved to be failures; but where it has had prominent recognition and its value has been properly appreciated, good roads have been made at a trifling expense.

After locating the road and marking out its course, the sides should be brought to the proper grade and finished by a layer of sod as a guide to further operations. In crossing a sloping surface it is not necessary to have both sides perfectly level, but the nearer this can be secured, with due regard to getting rid of surface water, the better it will admit of a neat finish and the more easily will it be kept in repair.

The road bed is then formed by excavating and removing the soil to a depth of six inches at the sides, curving slightly higher in the center, and made perfectly smooth by rolling, producing a uniform surface upon which the material of the road is to be placed.

The best stone for road metal is tough granite. Hard brittle stone is more readily reduced by pressure, but in a well-kept road this difference is not important. It is, however, all important that the stones should be broken small. The largest should easily pass through a two-inch ring, and if one-half of them are small enough to pass through a ring of only one inch diameter, the road will ultimately become all the more compact.

The road bed should be filled with this broken stone to a level with the sides, increasing in depth toward the center at the rate of one inch to the yard. Thus, a road sixteen feet in width would have a depth of about nine inches in the center. The utmost care should be applied to regulating the surface, and the smaller stones should be used on top, in order to secure an even, compact, carefully-molded grade, which should be compressed by repeatedly passing a heavy roller over it, wedging every stone, and making the surface almost as smooth and solid as a pavement. A thin layer, not more than one inch in thickness, of fine clayey gravel should then be evenly distributed over the stones, and the roller again applied until the surface becomes homogeneous, firm, and close.

The surface of the road will thus be higher than the sodded edgings, water will therefore pass readily from it, and one of the main points of keeping a good road will be secured. This will form a first-class road for ordinary carriage drives, or for all purposes required in public parks or private grounds; and, if kept in good surface by frequent rolling, so as to prevent the forming of ruts while it is settling; and, if a facing of gravel is applied when necessary, it will permanently fulfil all requirements of a good road.

The quality of gravel deserves notice. Wash gravel, consisting only of sand and rounded pebbles, should never be used. No amount of pressure will render it firm, and it is the most disagreeable material to walk upon. The best gravel is that to be found in banks composed of pebbles mixed with reddish clay; and the stones must be small. No detail in road-making is of so much importance as this. If a wagon wheel or the foot of a horse press on one extremity of a stone the other

end of it will probably be slightly raised, allowing small particles of sand to fall into the crevice, when the stone is loosened, and will roll on the surface; hence the necessity of using only very finely divided stones on top, so that they will be smaller than the pressing point, and not become disarranged from leverage or compound action.

Where stone cannot conveniently be obtained, the road bed may be filled with refuse matters of many kinds, such as coal ashes, clinkers from furnaces, and shells. Oyster shells are plentiful in many places near the seaboard, and form an admirable road; but the permanency, as well as efficiency of these materials in a road bed, will depend altogether upon the care of surfacing with proper gravel. Where it is impracticable to procure, or deemed inexpedient to use, any of the foregoing materials, an earth road may be rendered very serviceable by proper attention to the leading principle—that is, to keep it dry. In this case, instead of excavating a road bed, slight excavations should be made at the sides and the material spread over the center; and that surface water may pass to the sides more rapidly and thoroughly, a greater convexity may be given to the curve. In some sections of the country good roads are kept up in this manner, but they are carefully repaired whenever necessary, and all ruts and tracks are filled up as soon as they are formed. The same general principles apply to the formation of walks and foot-paths. The depth of material, however, need not exceed a few inches. It is certain that much unnecessary expense is frequently laid out upon mere foot-walks. A porous, gravelly, or sandy soil is in itself a good walk if properly shaped. Such walks admit of greater convexity than carriage roads, which is equivalent to a saving of material. Walks should be well filled up. There is no more disagreeable object, or one that conveys so meager an expression, as deep, raw edgings to a walk, looking as if they had been trimmed with a plow. Walks in this condition may be serviceable as water-courses, but they are not comfortable foot-paths.

FORMATION AND MANAGEMENT OF LAWNS.

A fine lawn is the most beautiful of external ornaments. Soft, velvety, elastic turf, smoothly shorn and of fine color, is always pleasing, but not always attained. Formerly the emerald lawns of European pleasure grounds were considered to be unequalled; and it was thought that nothing approaching to their beauty could be realized in this climate of scorching suns and summer droughts; but it has been demonstrated beyond any doubt that lawns may be produced and maintained here, as fine as those to be found in any country.

The primary requsite is thorough preparation of the soil. Without this, failure is probable, but if properly done at the outset, success is certain, with subsequent intelligent management. First of all, a good foundation must be laid by draining and subsoiling, trenching, manuring, or otherwise loosening and enriching the soil. With limited lawns, spade-trenching will be at once thorough and permanent; but, where a plow and other implements can be used, the work may be executed much more economically, and, by using the subsoil plow in connection with the common surface turning, a depth of eighteen inches will be reached, which, on ordinarily good corn-producing lands, will be ample preparation for a good lawn. Previous to the final plowing a heavy dressing of manure should be applied. This should be well decomposed, more especially if the soil is partially of a gravelly or sandy character.

The surface must be rendered smooth and regular. Careful plowing

can accomplish much toward making a smooth surface; but whatever the expense may be, the finish should be made perfect before sowing the grasses. There are two seasons for sowing—autumn and spring, either of them appropriate; and the choice will depend upon circumstances, and is of secondary consideration, compared to the preparation of the land. To get rid of weeds and clean the ground before laying it down to grass, it is a commendable practice to plant it with early potatoes. These, if cultivated with ordinary care, will soon cover the surface with their leaves, and prevent the growth of weeds; and the operation of digging up and removing the crop tends to pulverize and loosen the soil. The potatoes can be removed and grass seed sown by the middle of August to the middle of September, and the grasses will vegetate and cover the surface before frosts. A top dressing of thinly sprinkled manure will protect the young plants during the winter, and a good thick-set lawn will be secured early in the following summer.

In hard clayey loams, where a sufficiently comminuted surface is not so easily obtained, the ground should be prepared in the latter portion of the year, and plowed over, so as to leave a rough surface to be acted upon by frost during the winter. This will insure a friability not easily attainable by mechanical means on tenacious soils. The seeds should be sown as early as can be done in the spring, but not until the ground is dry. Working a clayey soil when it is wet is ruinous to the future crop.

In the immediate preparation of the ground before seeding, the surface should be pulverized by the harrow and roller if necessary. The seed will be sufficiently covered by passing a light harrow or roller over the ground. The former is best in clayey or baking soils, and the roller on light and sandy soils.

The best grasses for permanent lawns are red top (*Agrostis vulgaris*,) and June grass (*Poa pratensis*.) The following proportions have been used in the lawns of the Department, with great satisfaction: one bushel red top, two bushels June grass, one quart timothy, and two pounds white clover, to each acre of land. These should be thoroughly mixed before sowing. This is heavy seeding, but experiments demonstrate that a good lawn can be secured only by seeding heavily, when sown in the spring; autumn sowing may be thinner, but the thick seeding will be the most satisfactory. There is no grass equal to the June grass for fine lawns; this is also known as green grass, and Kentucky blue grass. The red top also forms a good sward where the soil is good, and the summers comparatively cool and moist; but during dry warm weather it becomes hard and wiry. The timothy grass vegetates quickly and greatly assists the growth of the others. The clover is also valuable, in rapidly producing a thick close sod.

The practice of sowing oats, barley, or other grains with the grasses, under the impression that they will protect the young plants from sun and drought, is altogether wrong, as it practically does much more harm than good. The larger growing plants rob the soil of its moisture to the destruction of the tender and more feebly rooting grass plants. No such protection is necessary even were it possible to supply it without injury. With fair preparation of ground, and seed put in as soon as practicable in the spring, the lawn will be fit to mow in June at latest.

A very successful improver, especially in the making of lawns, sows down in August and adds about two pounds of turnip seed to the acre. The gradual growth of the turnip foliage forms a congenial damp shade for the vegetation and spread of the young grass plants. The larger leaves of the vegetable also protect the grass against injury from the early frosts. Their gradual decay and ultimate removal are effected be-

fore the grasses are so far advanced as to be hurt by continuous shade, and a thick sward is secured before winter. A slight covering of strawy manure will be of advantage to autumn-sown lawns, particularly so if the soil inclines to be wet, and therefore liable to have the young plants thrown to the surface by the alternate action of freezing and thawing. A heavy roller should be passed over it as early in the spring as the firmness of the soil will admit, in order to tighten the earth around the roots, and press down such plants as have been loosened during the winter.

While it is true that a fine lawn cannot be produced without good preparation, it is equally true that a fine lawn cannot be maintained without frequent mowing. The recent improvements in lawn mowers leave but little to be desired so far as mowing facilities are concerned. They also roll the lawn at the same time that it is cut, which is essential to the most perfect keeping. That which was formerly regarded as a formidable operation is now one of the easiest, and the lawn is kept in good order at less cost than any other portion of the pleasure grounds. One of the best points in the lawn mower is its incapacity for cutting long grass, thus compelling frequent mowing, which is the great secret in keeping a superior lawn. Mow early and often is the rule. Even on newly seeded lawns the mower should be at work as soon as the grass is high enough to cut; indeed much injury results from procrastination at this time; weeds will gain the ascendency, and unequal growths follow. A lawn sown down in April was cut six times before the 1st of August, and had the appearance of an old thick set sod.

Neither in the preparation and formation of a lawn, nor in its keeping in this climate, are there any half-way compromises. The work must be done thoroughly to begin with, and then timely attention to cutting all through the growing season will insure a satisfactory result. Neither soil nor climate can justly be blamed for poor lawns, although it is a very convenient mode of shifting responsibility, and one frequently adopted.

As already remarked, lawn mowing machines will not operate to any good purpose where the grass is long; hence it has been recommended to leave the cut grass as a mulch. During the first year this course may be followed with advantage; but experience shows that a long continuance of the practice injures the lawn very materially, particularly during early spring, or late in the season. In the hottest portion of summer the cut grass dries up so thoroughly as to be but of slight influence either way.

The lawn will be benefited by a top dressing once in three or four years; not, however, by throwing over it an unsightly covering of rough, strawy litter, which, however beneficial, is not commendable in neatly kept grounds. A compost made up of fresh stable manure and any ordinarily good surface soil, thrown together in layers, and intermixed and pulverized by frequent turnings during the summer, will be in condition for application any time in early winter. This should be evenly distributed, broken up, and raked in among the roots, taking advantage of frost to assist in the work of disintegration, and removing the rougher portions altogether before rolling the lawn in the spring.

BELTS OR MARGINAL PLANTATIONS.

In suburban districts, where surrounding properties are likely to be improved and the scenery is liable to be changed at any time, too much value should not be given to neighboring views. It frequently occurs that the site for a dwelling-house is selected mainly on account of its commanding certain distant views, even to sacrificing other important con-

siderations in order to secure the prospect, and before the house is completed, the fine views are obstructed by operations on an adjoining property. In localities of this kind the interest of the position should not so much depend upon external beauties that are beyond control, as upon the internal improvements and local objects. Preliminary to this acquirement the grounds should be isolated by an umbrageous boundary of trees and shrubs, which will form a pleasant margin to the ground improvements, and provide that seclusion, retirement and privacy which are always congenial to home comfort.

Whether the place is large or small, a carefully planted boundary of selected trees and shrubs should encircle that portion of the grounds appropriated to gardening purposes. With regard to small places in thickly populated neighborhoods, this should be the first consideration. The place will thus be made to look larger and the house can be partly surrounded by a somewhat open lawn, which will be distinctly defined and fringed by the border of shrubs. In grounds of greater extent, shelter and protection, to both plants and animals, will be largely secured by thickly-set evergreen trees on the most exposed quarters. Distinctiveness of arrangement will also necessitate the formation of a well marked division between the garden, the lawn, and the open fields beyond, and here a continuous belting of foliage will serve to render the boundary line more pleasing if not less conspicuous.

Much of the efficiency, as well as the beauty of this boundary belt, will depend upon the form of its ground plan, as well as upon its sky outline, which is a curving line, widening and narrowing at certain points, as heavy masses of planting may be made to hide deformities, or openings left through which to view the distant scenery. In arranging openings it is not necessary to arrest the continuous line of shrubbery. This can be maintained by using very low growing plants opposite to the selected openings. This will further have the effect of varying the sky outline, both by elevation and perspective. The projecting points giving space for larger growing plants, will enhance variety in sky outline. These occasional masses of heavier plantings produce a pleasing variety of effect when contrasted with open spaces of lawn and groups of low-growing shrubbery.

The selection of the species and varieties, as well as the disposition of plants in a marginal border, requires skill and forethought. The proper gradation of heights, the contrasting and harmonizing of forms and colorings of foliage and flowers, and the general adaptation of the whole to the extent of grounds, and to the requirements of the architectural and other improvements, will influence, to a certain degree, both the selection and disposition of the plants.

Where the grounds are so extensive as to admit of a plantation belt varying in width from fifty to two hundred feet, thus affording space for the growth of the largest trees, the selection of sorts will be less difficult than where the space limits the border to a maximum breadth of fifty feet. The following list includes some of the best trees of the smallest size, suitable to small grounds:

Acer campestre.
Acer Pennsylvanicum.
Amelanchier Canadensis, var. *botryapium.*
Aralia spinosa.
Carpinus betulus.
Cercis Canadensis.
Chionanthus Virginica.
Cornus florida.
Elæagnus angustifolia.
Fraxinus viridis.
Halesia tetraptera.
Hamamelis Virginica.
Kolreuteria paniculata.
Laburnum vulgare.
Maclura aurantiaca.
Magnolia conspicua.
Magnolia glauca.
Paliurus aculeatus.
Prunus mahaleb.
Prunus padus.
Ptelea trifoliata.
Pyrus aucuparia.
Pyrus coronaria.
Shepherdia argentea.
Sophora Japonica.

FENCES AND HEDGES.

Some sort of fence is usually necessary to guard against intruders, or to designate ownership, and the kind of fence used will generally be governed by necessity.

Whatever materials may be used for outside fences, they should be strong and substantial. Inside fences for such purposes as that of separating the lawn from the vegetable garden may be of lighter construction; especially if a fence crosses a lawn, as seen from the house with an open view beyond, it should be as light and elegant as is consistent with strength and durability. In such cases it is often desired to conceal the fence, as an intrusive object in the landscape, by adopting the sunken fence. This may be described as a ditch-like excavation four or five feet in depth, finished by a perpendicular wall on the lawn-side, and the ground flatly sloped on the opposite.

The propriety of persistently concealing the fence in such positions may be questioned. Utility is a strong element of the beautiful, and if no visible barrier intervenes between the pleasure ground and a grazing field, we at once condemn the incongruity. We cannot distinguish where the flower garden ends or the grazing meadow begins, and must suppose that the cattle can perambulate the flower garden if they choose; we can imagine the result, and we feel that a fence becomes a necessity to separate objects that cannot well be united without injury to one or both. Wire fences are well adapted to this purpose, as they are so light as not materially to interrupt the view; and if properly constructed, are sufficiently strong and permanent.

Even in those happy communities where cattle are not permitted to run at large, some kind of fence will be necessary to designate boundary lines of property. It has been claimed that the highest degree of rural beauty is a village without fences, or any other distinctive marks to properties. As well might it be claimed that the best arrangement in a picture gallery will be produced by taking the paintings out of the frames and nailing the canvas to the walls. The love of exclusive possession is a mainstay of society. Well-defined boundary lines to property greatly enhance its enjoyment, especially when applied to lawns and gardens.

For this purpose the live fence is by far the most appropriate, and that formed of evergreen plants the most permanently beautiful. The Siberian arbor vitæ, Nootka cypress, and hemlock spruce are among the best for northern climates. In the South the Chinese arbor vitæ, Japan euonymus, and other evergreen shrubs may be added to the list. If deciduous plants are preferred, a selection may be made from the following list: Japan quince, buckthorn, elæagnus, Japan privet; and, if a somewhat formidable fence is desired, the Osage orange and honey locust will answer that purpose.

Hedges are also useful as shelter to gardens, rendering them earlier, more productive, and greatly exempt from casualties of climate and locality. In the growth of all kinds of small fruits, as well as those of larger orchard growth, shelter is always of the greatest benefit. Many of the diseases of our fruit trees and imperfections in the products can be effaced by sheltering hedges and plantations—facts that are now being fully appreciated by fruit-growers.

In grounds of very limited dimensions, where the boundary lines are at no great distance from the house, an evergreen hedge set inside the fence will afford great relief to the eye and form a background, as it were, to the shrubbery and flower borders. The stiff line of the hedge

can be modified in appearance by planting small, diversified groups of shrubs, or low-growing evergreens along its front. A continuous border varying in width and of curving outline, running in a direction parallel with the hedge, and thickly planted with flowering shrubs of variety, interspersed with such flowering herbaceous perennials as hollyhocks, phloxes, chrysanthemums, delphinums, &c., is one of the best modes of treating a small pleasure garden and lawn.

ROCKERIES.

A rockery properly located and tastefully arranged is capable of affording much of interest and pleasure to those who can appreciate the beauties of nature. It is not advised to attempt the imitation of rocky scenery, which can rarely be successfully accomplished, even with the command of unlimited means. Abortions of this kind, where the means have been made more conspicuous than the end, have tended to discard rockeries from situations where they would be highly prized, were their real purpose fully understood.

The simplest form of rockwork may be described as a mound of soil covered with stones; and its purpose that of securing conditions for the culture of the native plants of our woods and dells, as mosses, ferns, and others of similar habits, which will not flourish in the ordinary borders or beds of the flower garden, where they are too much exposed to sultry suns and drying winds.

A secluded spot or corner of the pleasure grounds, shaded by trees, but not directly under them, is the position for a rockwork of the kind in question. Here, concealed from all points by an inclosure of shrubbery, or by an evergreen hedge, and approached by a rustic pathway through a leafy thicket, the rockery may be located, without any violation of good taste or interference with other and more ambitious decorations.

A basin to contain water may be cheaply constructed of brick and cement, and will add very much to the variety of the plants that may be grown. Shade and humidity, which are essential to the growth of many woodland plants, such as the sarracenias or pitcher plants, and also a constant evaporation during dry periods, will enable these, and plants of similar habit, to flourish as luxuriantly in an artificial state as they do in their native wilds.

A circular basin, eight to ten feet in diameter and twelve to sixteen inches in depth, surrounded by a rock-covered mound of soil, of varied breadth and elevation, will afford space for a large number of plants. It will also allow scope for tasteful arrangement, both in the construction of the work and in the distribution of the plants. If some of the largest pieces of rock are allowed to project over the water, in varied shapes and masses, some of them forming foundation for miniature perpendicular cliffs, and others for rapidly receding cavities, a pleasing play of light and shadow will be thrown over the surface of the water. An additional feature may be given by running through and around the rockwork a concealed pipe, with numerous small perforations over its surface, through which water will be conducted to the plants, trickling over the rocks and dropping into the pool below, producing at once a charming rural effect and a congenial atmosphere for the vegetation.

This, or some similar simple method of arrangement, will usually be more satisfactory than an iron or even a marble fountain, with numerous fanciful jets and basins, supported by questionable statuary, displayed in a conspicuous position on the lawn.

By the use of small stones and cement a center ornament may be erected in the basin, and a jet inserted, through which the water is delivered in a finely divided spray. This will provide hygrometric temperature peculiarly adapted to such situations and objects.

There are but few country places where the means for securing these specialties cannot readily be obtained. The water supply may not always be convenient; still, by exercising a little ingenuity, plans may be devised for its introduction, either by utilizing the waste from cisterns or forcing it into elevated receptacles. It may be mentioned that small jets are sometimes supplied by rain water collected in cisterns, although this is not recommended as a plan likely to prove satisfactory.

A species of rock garden of more elaborate character may be formed by laying out a small geometric plan of raised beds of earth, supported by irregularly shaped stones. Old tree-roots may also be used to elevate and diversify the sky outline. These will in time become covered with foliage of creeping plants, ferns, mosses, and other low growths. The beds should be planted with low-growing hardy evergreens, such as various species of *Juniperus*, *Cupressus*, *Biota*, *Thuja*, *Taxus*, and *Retinospora*. The Mahonias are well suited to plant in such positions. Yuccas are admirable, giving a somewhat oriental character when massed in groups. Larger trees may be used where space will admit. The hemlock-spruce is beautiful everywhere; the silvery deodar cedar will give variety of color; and the Pyracanth, Rhododendrons, and Kalmias, with many others, may be formed into picturesque groups of great beauty, depending very much, however, upon their location and skillful arrangement.

The more robust plants may be pruned, when necessary, to keep them within prescribed limits; and shaded spots will be found where the Epigæas, Mitchellas, Ferns, and kindred plants, can be introduced, desirable and interesting either for their floral beauty or their historical and botanical associations.

WATER.—LAKES.

When appropriately introduced, the effect of water in pleasure grounds is always pleasing; frequently it is strikingly beautiful; and, of all the materials that enter into the composition of natural scenery, there are none that produce a greater amount of varied interest and beauty. It is, therefore, eagerly desired as an adjunct to the more artificial improvements of private residences, public institutions, and city parks, and is always a valuable acquisition where it can be secured.

To form an artificial lake, the first requisite is an ample supply of water at all seasons. There cannot well be a more unsatisfactory object in artificial grounds than a lake where the supply of water is insufficient to keep it properly filled, and where natural facilities for a constant supply do not exist its construction should not be attempted. The surface water, or casual supply derived from rains and snows, may be sufficient during winter and spring, but entirely inadequate to meet the evaporation during summer; and lakes that are dependent upon this source, and become partially empty and stagnant during the warm season, are as injurious to health as they are opposed to all correct ideas of beauty.

Water for ponds is sometimes procured from the discharges of underground drains; and where the drained area is extensive enough to furnish all the water necessary, which can be ascertained by observations

during summer, a pond may be excavated at the lowest point, allowing the surface of the water to be on a level with the discharge pipes of the drains. The excavated soil can be used in forming the banks of varied heights and configurations. The outline of the pond, like that of a belt of trees or shrubbery border skirting a lawn, should be varied and irregular, with bold points and deep indentations, and these should be few and bold rather than frequent and tame. The resemblance between a level lawn, surrounded by curved outlines of shrubbery, and that of a smooth sheet of water in a pond or small lake, with jutting banks and retiring bays, is very close, so far as relates to their artistic treatment in ornamental planting.

The most natural position for a sheet of water is in a hollow or low ground, occupied by a constantly running stream. It frequently occurs that small streams are so situated that by skillfully throwing a dam across the valley hollow through which the water runs a large surface may be flooded and the water permanently retained. The water level on the surrounding ground will probably show a beautifully varied outline which may be increased or rendered more definite by deepening bay-like recesses and adding to prominent or jutting points. This, together with the effects that may be produced by planting, will give variety to otherwise monotonous outlines.

In geometrically arranged flower gardens simple basins of water may be introduced with good effect either with fountains or without them. In these situations the marginal finish or connection between the grass and water should be of an architectural description. Any attempt made toward a rugged, or what is usually termed a natural looking finish, will certainly prove unsatisfactory.

ENTRANCE GATES AND CARRIAGE TURNS.

First impressions are strongly influencing, and oftentimes prove to be the foundation of lasting prejudices. A neatly designed and tastefully arranged gateway at the entrance of a property creates the favorable expectation of finding these characteristics pervading other improvements. An imposing entrance way, therefore, becomes an important feature; but it should always bear a close relation to the general style and scale of the situation; and, if it is architectural in design, should harmonize with the style of the mansion to which it is an adjunct; at the same time it may be more highly ornamented, keeping strictly in mind that no amount of mere decoration will compensate for any appearance of insufficient strength or utility.

Iron gates appear to greatest advantage when they are hung to stone posts or attached to pillars of masonry. A single block of granite, fashioned into a post, forms a very satisfactory support for an ordinary iron gate. Large, heavy, and elaborately constructed iron gates demand heavier and more massive supporting pillars, ornamented to correspond with the style and finish of the gate. The main or principal entrance gate to any place, even of the most humble description, should be placed on a line receding more or less from the line of the outside or public road, being connected with the latter by a curved line of fence. The extent of this recess will vary with the extent of the place, facilities of position, and size and style of the gate; but ten to thirty feet may be given as a range. Even in places of quite limited extent, the former distance will be sufficient to give a decided effect, without encroaching too severely on the grounds, and will establish a largeness of

expression to the whole surroundings. In placing posts for gates the mistake is frequently made of setting them parallel to the public road instead of having them at a right angle to the road to which they properly belong. When the private road leaves the public one at right angles, and continues in a straight line for some distance, the gate will, of course, be properly placed in a line parallel to the public road; but where the front lawn is small in extent and it becomes a necessity to branch the road suddenly to right or left, the importance of adhering strictly to the rule of placing the gate at a right angle to the carriage road will appear very conspicuous; for if the posts are set parallel with the public road, it will be found to be a matter of much nicety to drive a carriage through the gateway without either coming in contact with the post or allowing the horses to walk on the grass or road edging. Examples of this may be seen in most suburban districts.

The greater the inequality of the respective distances between the posts and the line of the outside or public road the more difference will there be in the length of the curved lines connecting them with the fence. One will be much shorter and have a different radius from the other; but this will not destroy the symmetry of composition which a gateway should possess, since the apparent utility of the arrangement will convey a strong reason for its adoption, which can be further increased by the judicious planting of trees; besides, it should be remembered that an expression of symmetry can be obtained without having a strict adherence to uniformity in details.

A space sufficiently large for allowing a carriage to turn is a necessary convenience to a house, and as near to the main entrance as practicable. In the front of very large buildings, a gravel space wide enough for this purpose is sometimes provided; but when the house is one of ordinary dimensions, and the grounds of only moderate extent, a large gravel space will very materially abridge the breadth of the front. The reflection of heat from gravel is not pleasant, neither is it so agreeable to the eye as the grassy lawn. Some of the objections to an open gravel space are removed by forming a circular carriage-way, directly in front of the house, inclosing a bed for shrubbery or a grass plot. The amount of roadway is, by this mode, somewhat reduced, but the evil of breaking up the front still exists; nor does it provide all the requirements of a carriage turn, as there is no alternative but to perambulate the circle when retiring; and the annoyance of having vehicles and animals obstructing the views from the principal windows of the house is also a great objection to this arrangement. The best position for a carriage-turn is beyond the house, so that a vehicle, after approaching the main entrance, can proceed onward, turn, and approach the house again in the opposite direction. The turn in this case can be partially screened from the house by planting shrubbery; and arrangements for tying horses can be made in unobjectionable positions where they will not present annoying features as seen from the house. This allows the grass or lawn to be carried closer to the building, the roadway only intervening, and the side grouping of plants can be executed much more effectively. The curve of the road, entering into the grounds on one side, will be balanced by a similar curve on the other side, toward the turn. In this proximity to a building, the walks, as well as artificial plantings, should be symmetrical in their tendencies, and in keeping with the formal style of treatment which such a position demands. The central view from the building will be open, and impart an expression of freedom and apparent extent of lawn, which is always pleasing, particularly in limited areas.

PLANTING ROADS AND AVENUES.

In the planting of straight roads and avenues it is essential to preserve regularity of line, as also uniformity in the color and shape of the trees. The nearest approach to the sublime in landscape gardening is in effects produced by extended uniform lines of trees. Continuity of line and uniformity of object, when combined with great extension, produce sublimity. Objects are sublime which possess quantity and simplicity in conjunction. It is not on a small rivulet, however transparent or beautifully winding it may be; it is not on a narrow valley, though variegated with flowers of a thousand hues; it is not on small elevations, though they are clothed with the most delightful verdure, that we bestow the epithet sublime; but it is upon Niagara, the Mississippi, the Andes, the ocean, the wide expanse of the firmament, or the immensity of space uniformly extended, without limit and without termination. To produce this effect it is, therefore, imperative that only one variety of tree should be used. Anything that tends to break up the uniform continuity will at once destroy it. A straight avenue, planted with a variety of trees of varied forms, some broad and spreading, others tall, pointed, and spiry, is as much at variance with good taste as would be a Grecian façade, furnished with columns embracing all the different orders of architecture. Among the best trees for planting wide avenues are the tulip tree, the sugar and the silver maple, lindens, sycamores, walnuts, oaks, and chestnuts. For narrower roads, those from sixteen to twenty feet in width, the Norway maple, the black and the white ash, the horse chestnut, and those of kindred habit, will be more suitable.

On wide and long avenues, in positions where a side view of the lines is prominent, the wall-like effect may be very much softened and toned down, by setting a double or even a triple row of trees, and this will be still further increased by planting each opposite row, respectively, with a distinct kind. An avenue of tulip trees will, in this arrangement, be well supported by an outside line of red maples; their forms will blend pleasingly, and the contrast of their spring verdure, and autumn colorings will be agreeable. In a similar disposition the sugar maple, sweet gum, and ash-leaved maple may be used. Such combinations may be indefinitely varied and adapted to the embellishment of avenues, as their extent and importance may demand or require.

In planting curving roads, the disposition of the trees will obviously be determined by the general character of the grounds through which the road passes.

In places of six to ten acres in extent, and in form nearly of a square or parallelogram, with the mansion placed one hundred yards back of the front line, the entrance gate may be judiciously set near one of the corners, and the road gradually curve to the building. A single continuous row of trees on one side of this road would have a monotonous effect, and a row on each side would destroy and completely break up any attempt at breadth of view. The road should rather appear to curve round and pass through masses of trees and shrubbery plantations. While attention may be given to partially shading the road, by planting suitable trees mainly on the south and west sides, yet these shade trees should form only a portion of groups, with an occasional isolated single specimen tree; or, what is still better, two trees of the same kind set six to ten feet apart, so that when they grow up they will give a distant appearance as of a single tree, with the additional variety of aspect when closely viewed. The plantings or groups should be

more extensive and massive on the inner circle, around which the road will curve, with frequent open vistas looking in upon the lawn. The width and length of the road and extent of lawn will designate the size of the groups, and also suggest the particular kinds of trees and shrubs of which they are to be composed. Shade trees may be thus introduced in sufficient quantities, even on winding roads, to answer the combined purposes of shade and garniture, without producing an appearance of strained effort to secure it.

Where the road is wholly on the southern side of the dwelling, deciduous trees should be used in front or near the building. If the entrance and road are north of the house, a straight avenue of evergreen trees will form an admirable feature, if ample space is allowed for both road and trees. The Norway spruce is, perhaps, the first choice of tree for such planting. The hemlock spruce is the more graceful, and the best adapted to short roads or narrow grounds. The Austrian, the Scotch, and the white pine may be used where the grounds are extensive. Even when the Norway spruce is used the parallel lines should be fifty feet apart, not only to admit of sun and winds to act directly on the roadway, but also to give ample room for the spread of the lower branches of the trees; and in no case should they be planted nearer than sixteen feet from the edge of the road; and when the larger and more widely spreading pines are used, a space of at least twenty feet should be given. A very meagre effect will result from planting close to roadways, narrowing them into mere strips, which for at least one-half of the year are seldom dry.

PLANTING NEAR BUILDINGS.

A mischievous error, and one too frequently perpetrated, is that of placing trees close to buildings. Although trees and shrubs are the chief decorative ornaments of a place, they become not only disagreeable but positively injurious to animal life, when closely massed around a habitation, by shutting out light, and preventing the rays of the sun and drying action of winds from exerting their salutary influence on the walls, which, in consequence, are constantly damp and unhealthy. Where large trees are allowed to spread and overhang the roofs, choking gutters and water leaders, and causing a deposit of mold and other fungoid growths as far as their influence extends, it is impossible for the house to be dry, comfortable, or healthy for human beings. Many of the older houses throughout the country are rendered almost uninhabitable by the dense surroundings of trees and shrubbery, and the evil is greatly aggravated when the trees are of evergreen species. Ventilation is produced by heat, and a building shaded from the rays of the sun by lofty trees, and sheltered from currents of air by thickets of shrubbery, is deprived of the influences most conducive to health, and is a fitting subject for the attention of a sanitary commission.

Plantings of the finer species of dwarf flowering shrubs may be placed in moderately large masses on the lawn near the house, without any great injury, if not too frequently repeated; but even the smaller growing shrubbery, if planted in continuous thickets near the building, in any except a northerly direction, will sensibly exclude the genial cool breezes so grateful during summer. A house nestling on the sunny side of an evergreen plantation is suggestive of comfort, and presents a cheerful, sheltered appearance during winter. It is as economical as it is attractive, as many persons can testify who have had the foresight to plant sheltering borders of evergreens in bleak and treeless situations, and in consequence are realizing a higher thermometric tempera-

ture; but even these, to be of greatest benefit, should not approach within one hundred feet of the house, at least not in mass. Isolated specimens of rare, or otherwise specially interesting trees, may be planted nearer, but only on the northern sides of the house.

A certain amount of shade is very desirable in connection with a house, especially in climates where, during a great portion of the time, it is more agreeable out doors than it is in rooms; yet it had better be secured by covered verandas than by trees. It is also more conducive to health to sit under a covered roof. Exposure to evening dews is a well-known fruitful source of sickness, and the partial protection afforded by the overhanging branches of trees is not sufficient when dew is falling.

Trees of the large-growing species should not be planted nearer than sixty feet to the walls of a dwelling-house. Such trees are the sugar and the silver maple, the sycamore, elm, linden, ash, chestnut, and poplar. Trees of medium growth, such as the Norway and the English maple, and others of this class, that do not attain a height of more than thirty feet, may be planted thirty to forty feet from the building.

Another disadvantage resulting from surrounding the building with a thicket of foliage is, that it shuts out the views of immediate and distant scenery, as seen from the house, at the same time the house, as an object of the local landscape, is completely hidden from view. If the architecture of the structure has received any study as a work of artistic design, it should in itself form a picture which, to be properly appreciated, must be seen and viewed as a whole, so that its proportions, outlines, elevations, and ornamental details may be taken in at one view. Even beds of low shrubbery, if abundantly introduced near the base of a building, will foreshorten the elevation, obstruct the view of the horizontal base line, and seemingly destroy architectural proportions. Many of the finest structures, both public and private, are ruinously shorn of their beauty by careless or ignorant planters, who, in their endeavors to beautify a building, succeed only in concealing those salient lines and projections that give it character and distinctiveness.

A proper connection of the house with its surroundings is the first point to which attention should be given in laying out grounds, as it is the most prominent and leading detail of improvements. A house should not appear to have risen out of the green lawn like a tree. It is necessary that some evidence should be apparent of suitable preparation having been made for the building; at least, a level platform of more or less width should project from the base line. The ground line should be level, and all walks should correspond with the lines of the ground plan. Zigzag and curving walks close to the straight lines of a large, or even the most humble building, are directly opposed to beauty or propriety; they are sure evidence of unskilled labor.

The principal front of a building should show a terrace, either architecturally treated, or at least with architectural appendages. The level line of terrace will furnish a uniform base to the building, and masses of low-growing plants may be introduced below the terrace where they will not interfere with the view of the structure. A few trees may be planted at the ends or in the rear, which will serve to connect the house with the grounds and their scenery, and this can be done without either hiding or overshadowing the building.

It has long been laid down as a general principle that round-headed trees contrast best with the prevailing perpendicular lines of Gothic architecture, and those of a pointed or conic shape with the horizontal of the Grecian. It may be questioned whether either of these rules is

sufficiently accurate to be worthy of consideration; certain it is that there may be found compositions of expressive beauty, where the arrangements are the reverse of those proposed in the general principle. It is perhaps nearer the facts to state that, in the arrangement of forms, harmony will prove more pleasing than contrast; but when applied to colors, contrast will develop the most distinct and expressive compositions.

GROUPING TREES AND SHRUBS, AND PLANTING IN MASSES.

Among the various operative details in landscape gardening, the arrangement of vegetation is the most important, and there is no other that shows so distinctly the artistic skill and arboricultural knowledge of the operator. While this is the most decisive as to the ultimate beauty and value of the improvements, it is acknowledged to be the least understood; for artists of considerable repute, who may establish grades, run lines of roads, and stake out places for groups and single trees, fail to designate the kind of plants to be used, thus leaving to mere chance the only features where artistic merit can be developed.

Some of the principal and most conspicuous effects that may be realized from grouping and placing trees, are as follows:

1. *The formation of distinct groups of the various species and varieties of trees.*—In planting public parks, college and school-house grounds, or private grounds, if of sufficient extent, a great amount of arboricultural interest will be induced by forming groups of certain families, genera, or natural orders of plants. It might be presumed that this mode of arrangement would sacrifice beauty, in order to carry out a mere mechanical system of disposition, such as may be seen in orchards, and would prove monotonous, and destitute of that variety which results from a combination of different species. This is to a certain extent true, where the grounds are not extensive, and the planting is confined to one principal group. In that case the use of diversified materials will invest the group with a greater variety of interest to the lover of trees, and that also without impairing the landscape effect, if the arrangement is properly carried out; but where the plantation is extended over several acres, the groups will be more definite and distinctive in character if each is chiefly planted with the plants of one genus. This may be partly illustrated by supposing that there are twelve principal masses to be planted, and twelve species of trees to be employed. If each mass is composed of a mixture of the twelve species, the result will be twelve groups of precisely the same character; whereas, if each group is strictly confined to one species, the groups will be entirely dissimilar, each forming a distinct feature. Thus groups of maples, oaks, birches, elms, &c., will follow in succession; and where whole families are thus connected, there will be sufficient difference in form and habit of growth among the species to give great variety to the group when inspected in detail, and at the same time the mass will present distinctive features peculiar to the genus represented. In ornamenting the grounds of colleges, and other seats of education, this mode of planting is particularly appropriate, affording admirable facilities for studying the individual trees, and comparing them with other species of the same family. The beauty of this arrangement will depend upon the harmonious connection of forms, and adaptation of the respective growths to certain positions in the groups.

2. *Planting evergreens with a view to forming a distinct winter scenery.*—No effective or perfectly satisfactory results will be produced from a

general intermixture of deciduous and evergreen plants. In forming shrubbery borders this distinction is not so strictly important as it is in the case of trees; but even in the arrangement of shrubs a far more polished and artistic finish will be given by placing the larger growth of deciduous plants in the background, and bordering toward the front with some of the low-growing evergreen species. One of the most desirable plants for an edging to a border of shrubbery is the *berberis acquifolia.* It grows in a compact, rounding form, and is beautiful at all seasons, whether in the glossy brightness of its varnished foliage during winter, the profuse cluster of its yellow blossoms in spring, the fern like delicacy of its young foliage in early summer, or when laden with clusters of its dark-colored berries. Where the mercury frequently sinks below zero this plant will not prove ornamental. The recent additions to our hardy evergreen shrubs have been notable and valuable. The *retinosporas* alone comprise great variety. The *enonymus japonicus*, and its silver and gold striped varieties, furnish valuable material where they will withstand the winters. The *taxus*, *cupressus*, *juniperus*, and *thuja* furnish numerous plants of dwarf growth for the shrubbery.

In respect to the heavier tree growths, it is clearly manifest that the finest examples of arrangement are those where evergreen and deciduous trees are treated as forming distinct scenery; and of these the evergreens are, perhaps, the most valuable; because they furnish a winter clothing to the landscape, with but little aid from deciduous plants, while the summer assistance of the latter only supplement and adorn the forms and colors of the evergreens.

To produce the best winter effect from evergreens, they should be planted mainly in the foreground, particularly on such projecting points as are conspicuous, so that while these points or groups may be rather widely separated, they will have a continuous appearance by the tops of those in one group apparently connecting with the lower branches of the group beyond, as seen from the principal points of view. An indiscriminate mixture of all kinds of trees is destructive of beauty. The deciduous varieties diminish the beauty of evergreens during winter by breaking up the continuity of color and repose so essential to the best effects, either in gardening or painting; and during the summer season, the more numerous branches and broader expanse of foliage of the deciduous trees, if close to evergreens, will overpower the latter, and, in time, completely destroy them, by an excessive amount of shade; and, also, by the extraction of moisture from the soil. For defining outlines, or rounding off groups, no plant is so appropriate, or can so well be adapted to any position, as the hemlock spruce. Its wavy branches convey a more finished impression than any other hardy evergreen, and no other can excel it either in beauty of growth, or general usefulness in producing the best effects of landscape gardening.

3. *To gradually blend evergreen and deciduous plantations by pleasing connections.*—The majority of evergreen trees are conical and pointed in form, while among deciduous species the prevailing habit is flat or round-headed; but trees of these opposite forms may be found in both classes. Spiry topped and conical forms are seen in the larches, Carolina cypress, Lombardy and other poplars; and round-headed evergreens are seen in the Scotch and the Austrian pine. Many species of the pine tribe, although of a pyramidal or pointed form, when the plants are young, assume an open, spreading habit, as they become older.

To connect evergreen and deciduous groups, those trees that partake of intermediate characteristics should be employed in blending the two classes, where the plantation is continuous; and where a more distinct,

but not an abrupt, line, of separation is required between the two, it may be judiciously accomplished, and the margins of each group be toned down, by introducing a few of the most graceful trees of both classes, such as the Norway and the English maple, negundo and yellow wood among deciduous, and the hemlock spruce, Lawson's cypress, arbor vitæs, and *retinosporas* among evergreen species. The rather novel difference between the arboreal aspect and the botanical classification of the *Salisburia adiantifolia* renders it peculiarly appropriate for an intermediate position between evergreen and deciduous trees.

4. *To place certain trees in conspicuous positions.*—Trees that are pre-eminently notable, on account of their rarity, beauty, or botanical or historical associations, may be placed as isolated specimens in prominent positions on the lawn. This interpolation, however, should be carefully studied; a single tree, if wrongly placed, may destroy a fine picture. Indeed, it is everywhere evident that the greatest prevailing error in arranging ornamental plantations, is the oft-repeated single tree, dotting every spare surface with a plant, producing a spottiness quite opposed either to beauty or design.

Single trees may be made still more conspicuous by planting them on slightly elevated rounding mounds; this will add to their general effect and allow perfect freedom for assuming their normal habit of growth. Trees worthy of so distinguished sites, for their beauty of growth, are very numerous; but for extensive grounds, where the largest class may be introduced, the *Magnolia acuminata*, the sugar and the Norway maple, *Cladrastis tinctoria*, Osage orange, negundo, willow-leaved oak, and English maple, may be noted as a few of the deciduous; while among evergreens, the hemlock and the Norway spruce, Himalaya pine, Nootka cypress, and Siberian arbor vitæ, may be specially mentioned.

Of rare and interesting trees, the list is extensive, and will vary according to individual tastes and studies; the extent of ground and general disposition of other plants will also influence the selection and number of single specimens.

5. *Plant with reference to individual beauty, as also with regard to that resulting from a combination of forms.*—Isolating the trees, as alluded to in the preceding paragraph, will produce the highest degree of individual beauty and development. But to realize all the variety that may be obtained from contrast of forms, foliage, and flowers, requires much careful study and preparation. Irregularity of distances between plants will, in itself, affect variety in composition. Very little either of beauty or interest can attach to lawns where every tree is equidistant, or apparently so, from its neighbor, like so many cabbages or currant bushes. If we observe the disposition of trees in any natural group that attracts our attention, we shall learn that the influence of unequal distance, in massing foliage, and causing minor groupings of branches and stems, is very great. To produce a similarly pleasing variety of stems and outlines, it will be essential to imitate, to some extent, the mode in which natural groves are formed, even to placing several trees together so as to present the appearance of several stems issuing from the same root. A degree of naturalness will thus be imposed upon groups, even should there not be any attempt at contrasting or harmonizing forms; but this latter will show more decidedly the foresight and skill of the designer.

6. *To produce a pleasing sky outline to all heavy masses or distinct groups.*—The sky outline composition of groups is a pleasing and noticeable feature. The monotonous sameness in the aspect of a peach or an apple orchard is a familiar result and example of what may be intensi-

fied by closely planted masses of formal growing trees. But it is a rare occurrence to find such monotony in natural forest scenery. A great diversity of sky outline will prevail, especially on the margins of groves, where the foliage is continued by suitable undergrowths down to the surface of the ground. Such distinct and unique forms as the Lombardy poplar, deciduous cypress, larches, and similarly pointed trees, will give a spirited effect to the most common-place groups.

The edges of plantations composed of larger growing trees will be softened by the introduction of drooping forms; and one of the most beautiful compositions, with reference to direction and curvature of branches, as well as to sky outline, is that produced by surrounding two or three Lombardy poplars with a circle of weeping willows. The poplars should not be more than twelve feet apart, and should form one central figure; if spread out singly the distinctive feature of a spiry column will not be secured.

Similar effects may be secured with groups of evergreen trees. The balsam fir is admirably effective as a center to a mass of lighter colored evergreens, owing to its heavy, dark hue. The Scotch pine and the Austrian are well adapted, both in color and form, to accompany the balsam fir, and the beauty of finish can be added by introducing the wavy branchlets of the hemlock spruce.

7. *Plant with regard to autumn colorings, and the introduction of flowering trees.*—The cheerful appearance of flowering trees should be made a point of attraction in any arrangement of groups or masses. These can be introduced under any system, as they are mainly trees of the third class, such as dogwood, Judas tree, Virginia fringe, silver bell, &c. Their appropriate position is on the margin of groups, and an occasional dogwood, planted where its white involucres will be displayed against the darker color of evergreens, will brighten the early summer scenery. The dwarfer growths of *spiræas*, *forsythias*, *deutzias*, *cydonias*, and other species of flowering shrubbery, may also be introduced, with the finest effect.

In arranging trees for the purpose of producing strong contrasts from the changing colors of autumn foliage there is a wide field for the artist.

The most conspicuous colors are the scarlet of the sour gum, red maple, wild cherry, and some of the oaks; and the yellow of hickories, tulip tree, sugar maple, and others. The dogwood and sassafras are also decided in their fall colorings.

The beauty of groups will greatly depend upon their definiteness, distinction, and separation, by expansive, open, green lawns. These grassy openings are the lights of the natural picture, while the trees and vegetation furnish the shade. The error of too much planting is frequent, and disastrous in its effects. The open, clear, well-kept lawn should largely predominate; for, as Bacon remarked three hundred years ago, "there is nothing more pleasant to the eye than green grass kept finely shorn."

APPLES FOR THE SOUTHERN STATES.

The opinion has been prevalent, and still obtains to a certain extent, that the climates of the States south of Maryland are not adapted to the culture of the apple. This erroneous impression is not confined to the best apple regions of the northern and western States, but has been held by southern cultivators themselves, especially as regards good winter-keeping varieties.

That this impression has not originated because of climates unsuited to the healthy growth of the apple, is abundantly shown by the successful production of the summer and fall ripening varieties, but it is now recognized that the scarcity of good winter fruit is referable to the great mistake of selecting the winter varieties of the northern States, which, although well adapted to the districts where they originated, become summer and fall ripening varieties when grown in warmer and equally congenial climates.

Southern pomologists have long seen this matter in its true light, and have been quietly, but industriously, collecting winter varieties among the seedlings originating in these States, and they can now present a list of winter apples which, for size, beauty, and quality are equal to those of any other section on this continent, and possessing, in addition, a peculiar texture and solidity to be found only in fruit produced in climates where the season of growth is extended and genial, and the winters are of only moderate severity. It is not proposed, in this paper, to describe the climates or localities in the South best adapted to apple culture; these are well established, however, and the rapidity with which orchard-planting has been extended, leaves no room to doubt that its influence will be felt at no distant day in the fruit supply of our large cities, both north and south.

The following list includes a few of the most popular summer and fall fruits, and a selection of the best winter varieties. The outlines and engravings are from specimens received by the Department from Virginia, Georgia, and North and South Carolina.

We would here acknowledge indebtedness for much information upon this subject to C. W. Westbrook, Ridgway, North Carolina, H. R. Robey, Fredericksburg, Virginia, and especially to the veteran pomologist, Joshua Lindley, New Garden, North Carolina.

SUMMER APPLES.

JULIAN.

Originated in the South; fruit, medium size; form, roundish conical; color, yellowish green, finely striped with red; flesh, white, tender, juicy, and fine flavored, of best quality; tree, bears young and abundantly; fruit ripens from middle to end of summer.

AROMATIC CAROLINA.

Origin, South Carolina; fruit, full medium size; form, roundish oblate; color, greenish yellow, striped with red; flesh, yellowish, rich, and delicious; ripens in midsummer; tree, of vigorous growth, and a good bearer.

LARGE SUMMER QUEEN.

Origin, North Carolina; fruit, very large; form, oblate conical; color, pale green, lightly touched with stripes and blotches of pale red; flesh,

light yellow, rich, juicy, well flavored, and very good; a valuable cooking and drying variety; ripens about midsummer.

RED JUNE.

Origin, North Carolina; fruit, medium size; form, somewhat conical; color, clear red, very dark on exposed side; flesh, white, tender, and of pleasant flavor; ripens in early summer; tree, healthy and of vigorous growth.

HORSE APPLE.

Synonyms: Haas, Summer Horse, Hoss.

Origin, Nash County, North Carolina; fruit, large; form, roundish oval; color, yellow, frequently tinged with red; flesh, yellow, with a rich, juicy, acid flavor; good for cooking and drying.

AMERICAN SUMMER PEARMAIN.

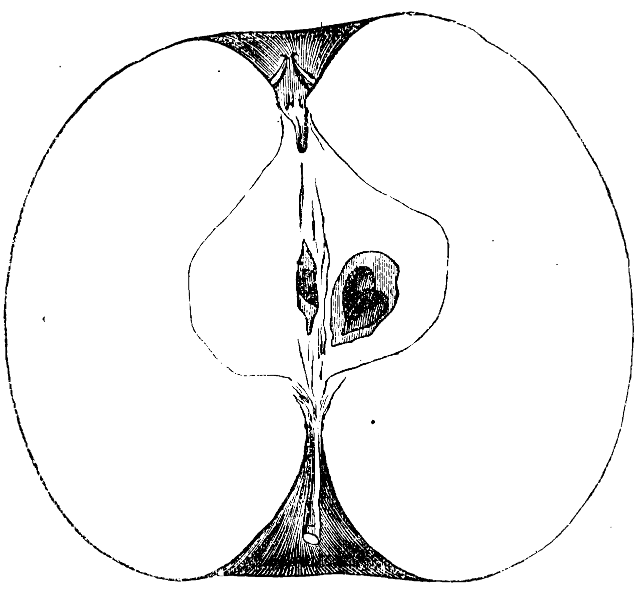
Supposed origin, New Jersey; fruit, above medium; form, roundish conical; color, pale green, covered much with dull red in stripes and blotches; flesh, pale yellow, rich, fine flavored, and quality best; ripens from midsummer onward; tree, moderately vigorous; comes early into bearing.

SUMMER CHEESE.

Fruit, above medium; form, roundish oblate; color, greenish yellow; flesh, rich, juicy, and fine flavored; one of the best late summer apples for all purposes; tree, an abundant bearer.

FALL APPLES.

HUNGE.



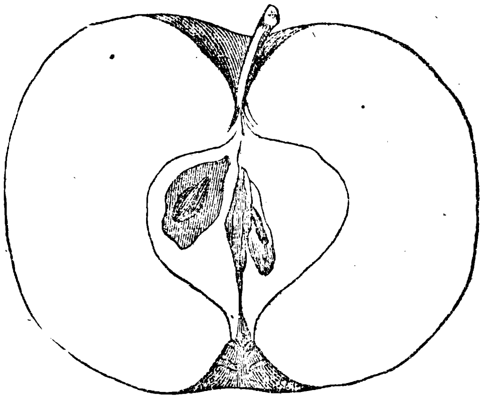
Origin uncertain, may be Jersey Greening of Coxe; fruit, large, round,

color, green, pale green, or yellow, when ripe, with faint brown blush; flesh, tender, good for cooking and drying, and valuable in North Carolina; ripens end of summer and early fall; tree, grows rapidly; early and abundant bearer.

HUBBARD'S SUGAR.

Origin, Guilford County, North Carolina; fruit, medium; form, oblate; color, greenish yellow, striped with red; flesh, yellowish white, rich, sugary, fine flavored; quality, best; ripens early in fall; tree, of healthy growth; young shoots tender.

BONUM.



Synonym: Magnum Bonum. (Downing.)

Origin, North Carolina; fruit, medium, (specimen below average;) form, roundish oblate; color, greenish yellow, shaded with crimson blush; flesh, tender, juicy, and excellent; ripens in October.

CUMMING'S RED.

Origin, Guilford County, North Carolina; fruit, large; form, roundish oval, somewhat conical; color, deep red; flesh, rich, juicy, and fine flavored; quality, best; ripens in October; tree, bears abundantly.

GOLDEN RUSSET.

Synonyms: English Golden Russet, English Russet, Russet Golden.

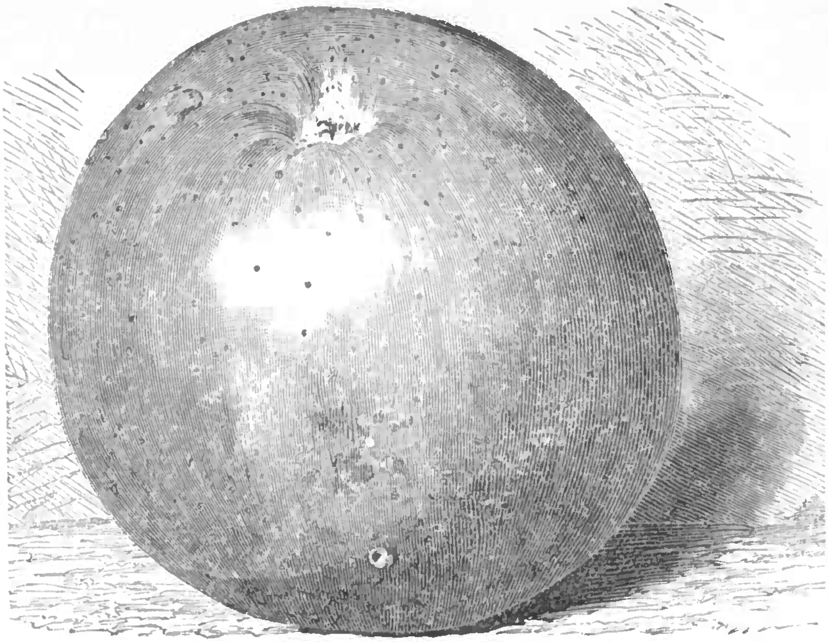
Fruit, small; form, roundish oblate; color, yellow, covered with a thin russet; flavor very rich and excellent.

BUCKINGHAM.

Synonyms: Queen, Fall Queen, Winter Queen, Kentucky Queen, Lexington Queen, Byer's Red, Frankfort Queen, Ladies' Favorite, Equinetely, Ox Eye, Bachelor, Merit, Blackburn, Henshaw, Sol Carter, Ne Plus Ultra, King, Red Gloria Mundi, Red Horse, (Downing.)

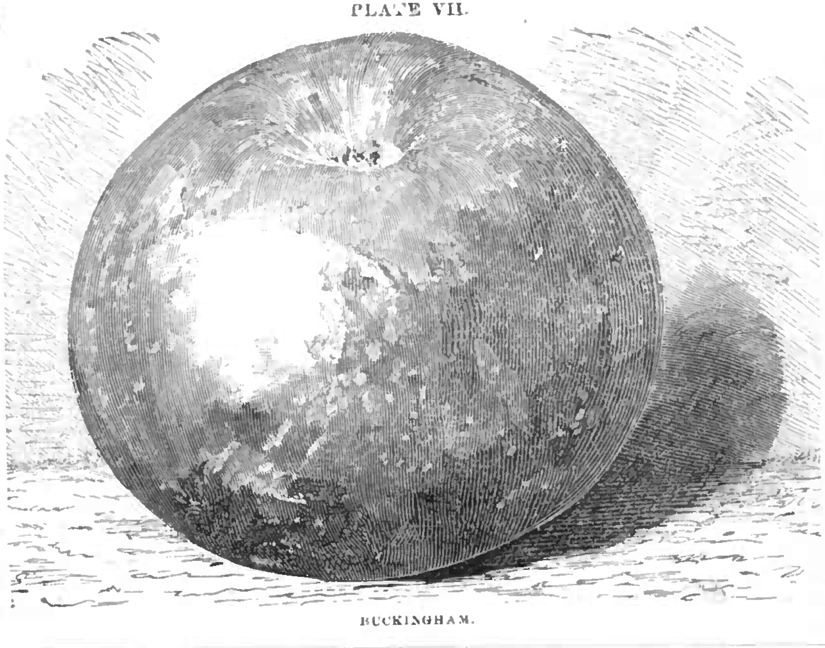
Origin, Virginia; fruit, large to very large; form roundish conical, often rather oblate; color, greenish yellow, handsomely striped with dull red; flesh, rather rich, juicy, fine, sprightly acid, sometimes quite acid; ripens in autumn; tree, of upright growth, and bears well.

PLATE VI.



HUNGE.

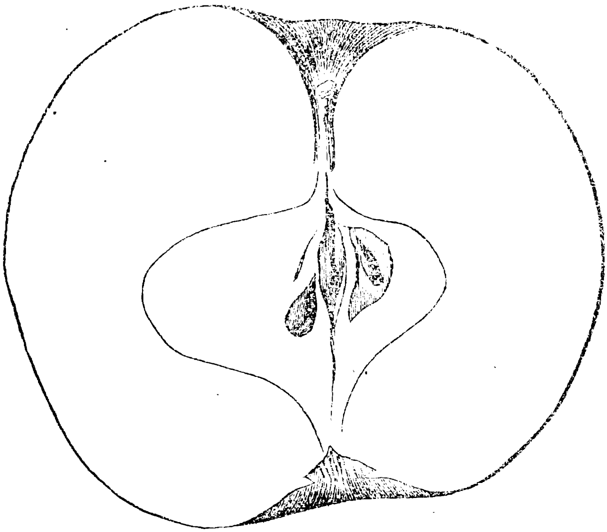
PLATE VII.



BUCKINGHAM.

WINTER APPLES.

WALKER'S YELLOW.



Originated in the South; fruit, large; form, roundish; color, yellow, striped with red; flesh, yellowish white, rich, pleasant, and well flavored, with a slight acidity; keeps well through winter.

CAMACK'S SWEET.

Originated in the South; fruit, medium size; form, nearly round; color, dull whitish green, mottled with russet; flesh, firm, tender, nearly sweet, juicy, and fine flavored; keeps well through winter.

BORAN'S WINTER.

Origin, Guilford County, North Carolina; fruit, large; form, oblate; color, light greenish yellow, striped with red; flesh, rich, juicy, slightly acid, and very good, a good winter apple; tree, of upright growth, bears young.

BROADNAX.

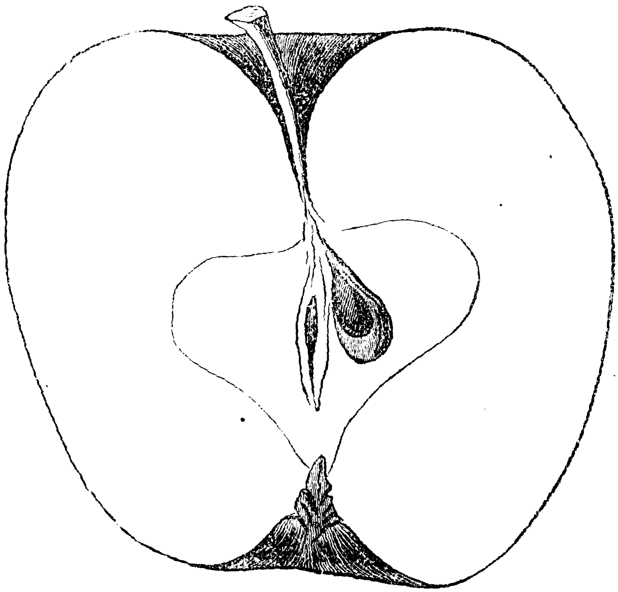
Origin, Rockingham County, North Carolina; fruit, above medium size; form, roundish oblate; color, clear pale yellow; flesh, yellowish, rich, juicy, and very good; keeps until a late period in spring and is very popular where known.

HALL.

Synonyms: Hall's Seedling, Hall's Red, Jenny Seedling. (Downing.)

Origin, Franklin County, North Carolina; fruit, small; form, roundish, slightly conic; color, clear red, sprinkled with whitish dots; flesh, yellowish, tender, juicy, and high flavored; highly prized for its good keeping and other qualities; tree, moderately vigorous, early and good bearer.

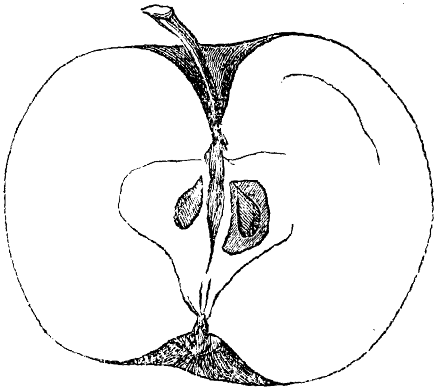
WHITE WINTER PEARMAIN.



Synonym: Campbellite. (Downing.) Michael Henry Pippin of some southern nurseries.

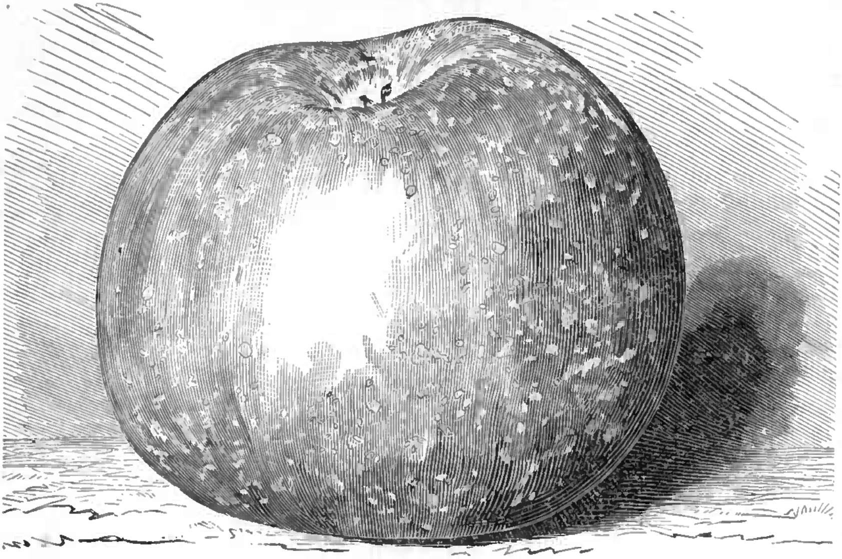
Fruit, rather above medium size; form, roundish conical; color, yellowish green, a little clouded with darker green in spots or blotches; flesh, rich, juicy, nearly sweet, and very fine; keeps until March; tree, of vigorous growth, and very productive.

GLADNEY'S RED.



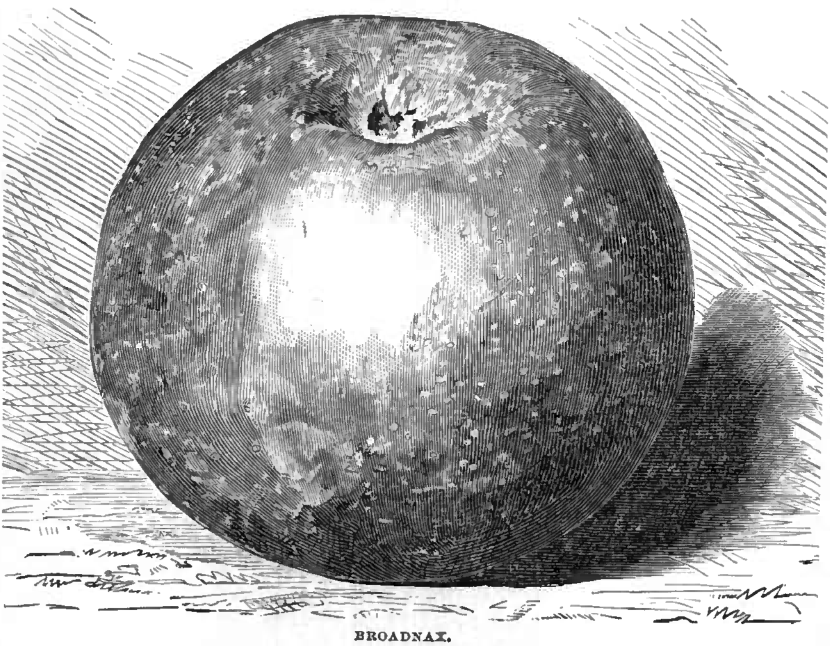
Origin, Mississippi; fruit, below medium size; form, roundish oblate;

PLATE VIII.



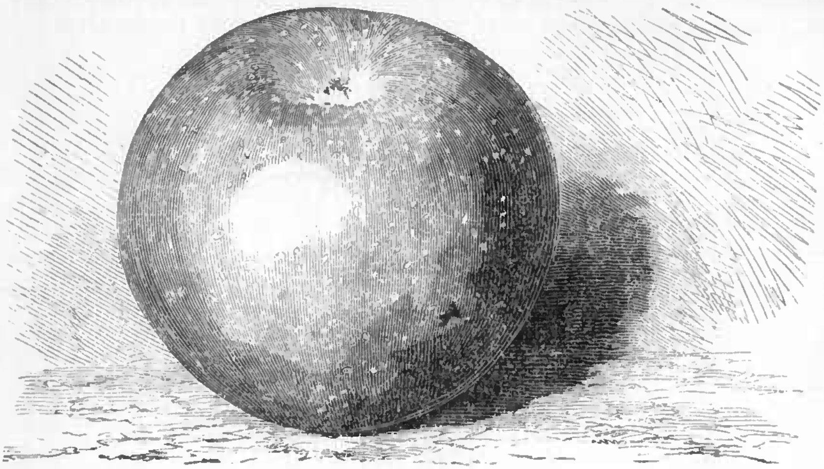
BORAN'S WINTER.

PLATE IX.



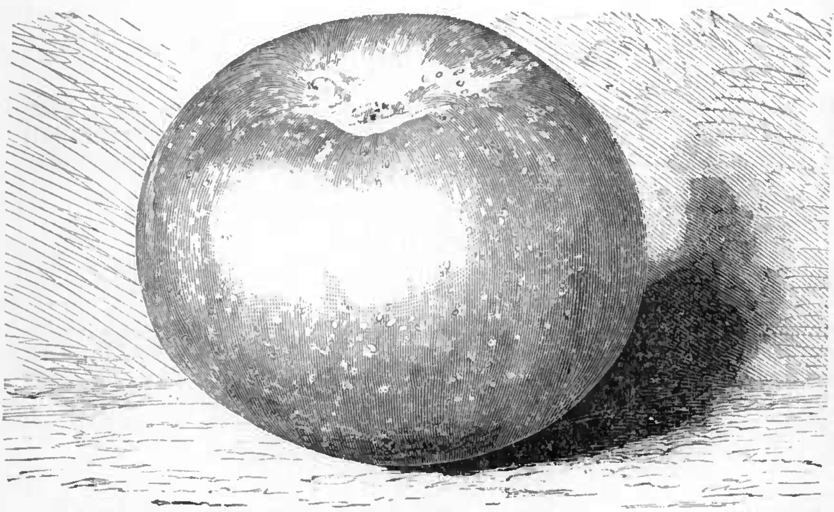
BROADNAX.

PLATE X.



HALL.

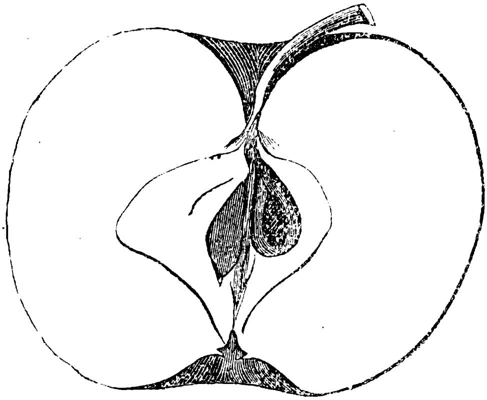
PLATE XI.



EDWARDS.

color, pale green, turning to light yellow when ripe, striped with red; flesh, yellowish, rich, juicy, and very fine flavored; keeps till late in spring; tree, healthy growth, bears when quite young and is very productive.

EDWARDS.



Origin, Chatham County, North Carolina, supposed to be a seedling of the Hall; fruit, rather below medium size; form, roundish oblate; color, greenish yellow, delicately striped with light red; flesh, fine grained, tender, rich, juicy, and excellent; keeps well till March; tree rather spreading in growth, stout vigorous shoots, foliage deep green, large and glossy in appearance; fruit borne mostly in clusters of from five to seven well formed specimens.

PAYNE'S WINTER.

Origin, Guilford County, North Carolina; fruit, medium size; form roundish oval, somewhat conic; color, green, turning to pale yellow when ripe, sometimes with a blush; flesh, rich, juicy, and fine flavored; quality very good, and a good keeper.

RAWLE'S JANET.

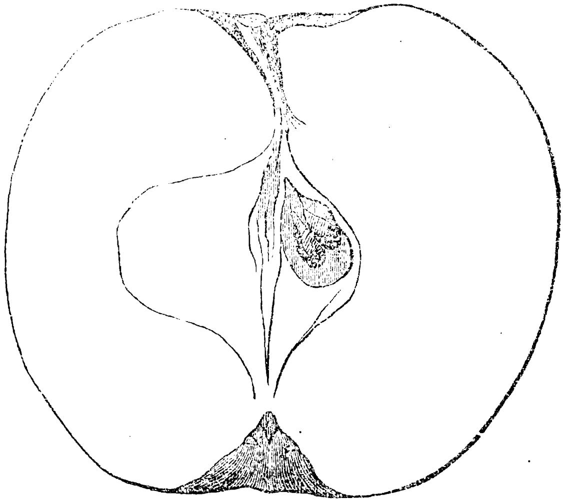
Synonym: Neverfail.

Origin, Virginia; fruit, full medium size; form, oblate conic; color, greenish yellow, striped and shaded with red; flesh, rich, juicy, and fine vinous flavor; tree, of strong spreading growth; blooms late, is not hurt by late frosts, and bears regularly; hence its synonym.

LIMBERTWIG.

Fruit, full medium size; form, roundish oblate, somewhat conic; color, greenish yellow, shaded with dull red, sprinkled with light dots; flesh, whitish, rich, with slightly acid flavor, a fine table, and best cooking apple; keeps well through winter.

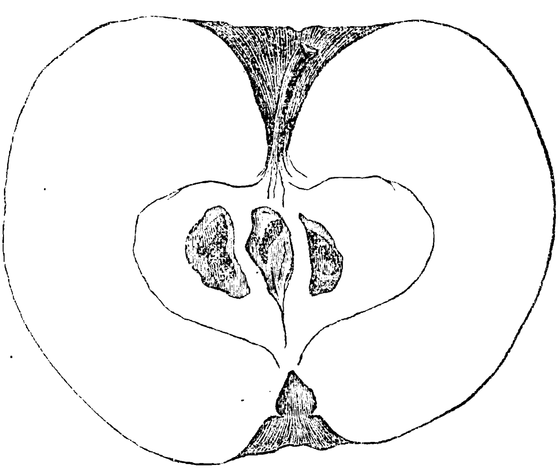
FAUST.



Synonyms: Faust's Winter, Foust. (Downing.)

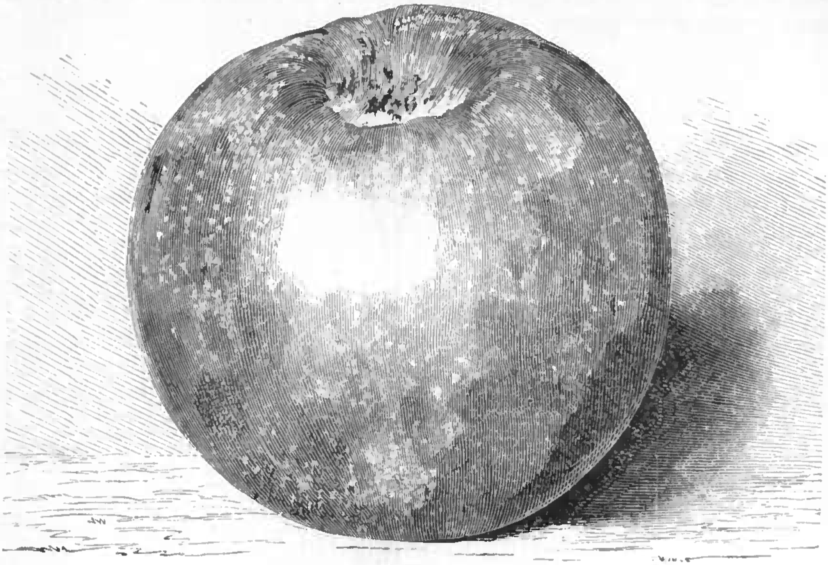
Originated in Pennsylvania, but grown in the South for the last century; fruit, medium size; form, roundish oblate; color, yellow; flesh yellowish white, mild, pleasant flavor; ripens during winter; tree, of good growth and bears when quite young.

HOYAL'S GREENING.



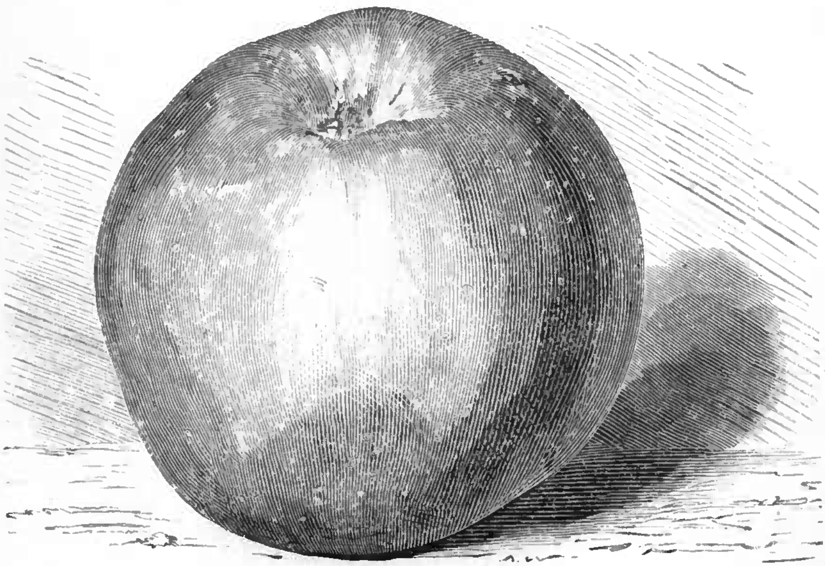
Of southern origin; fruit, medium; form, roundish conical; color, green, rarely blushed; flesh, white, rich, juicy, very agreeable, and keeps very

PLATE XII.



FAUST.

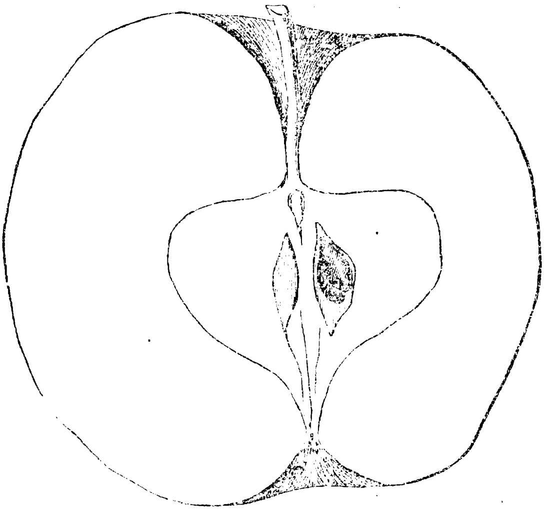
PLATE XIII.



GOLDEN WILDING.

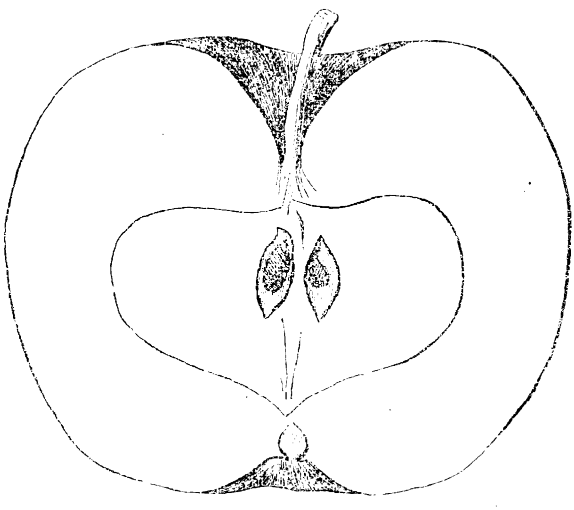
well during the winter; tree, very luxuriant in growth and bears abundantly after a few years.

SHOCKLEY.



Origin, Georgia; fruit, about medium size; form, roundish conical, rather oblong; skin smooth, much covered with red, often entirely so; flesh, moderately rich and juicy, fine flavor; keeps well until May; tree, of fine growth, bears early and regularly.

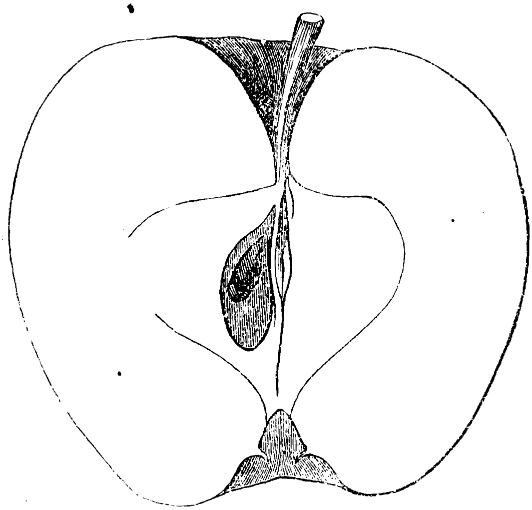
GOLDEN WILDING.



Originated near Fayetteville, North Carolina; fruit, medium; form,

roundish oblate; color, yellow with faint dull blush; flesh, yellow, rich, and fine flavored; keeps until spring; tree, healthy, bears early and abundantly.

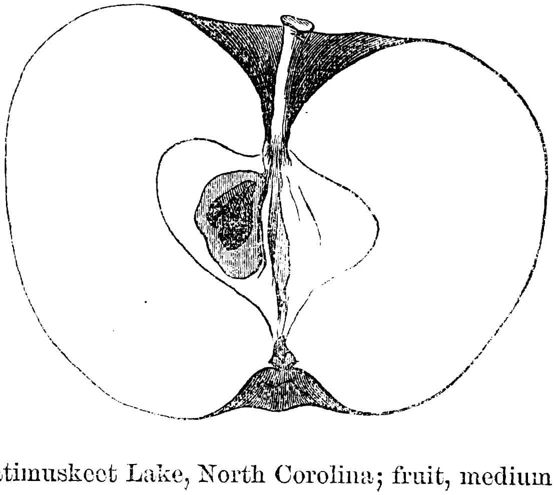
CLARKE'S PEARMAIN.



Synonyms: Yellow Pearmain, Gloucester Pearmain, Columbian Russet, Golden Pearmain. (Downing.)

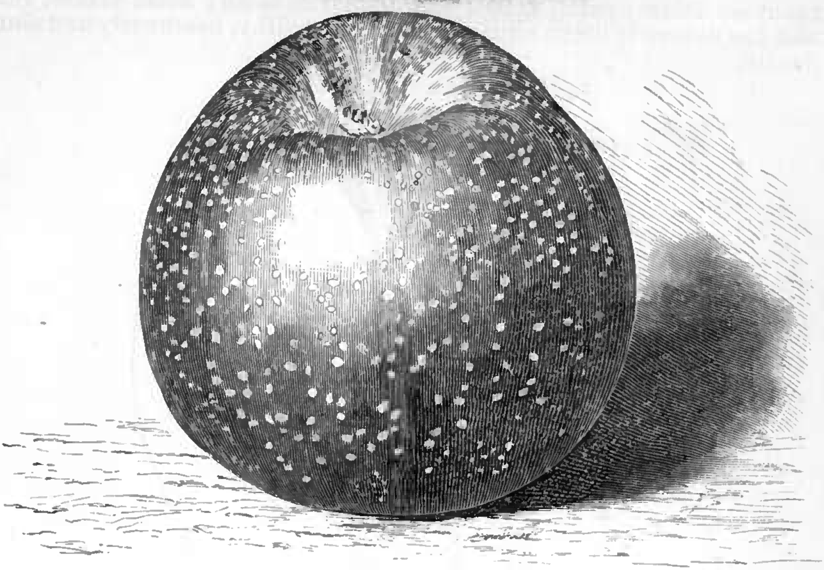
Fruit, medium; form, roundish conical; color, greenish yellow, much striped and blotched with dull red; flesh, juicy with some acidity, but pleasant flavor; keeps until February; grown in the south for one hundred years; tree, moderately vigorous, bears young, and fruit uniformly of good size.

MATIMUSKEET.



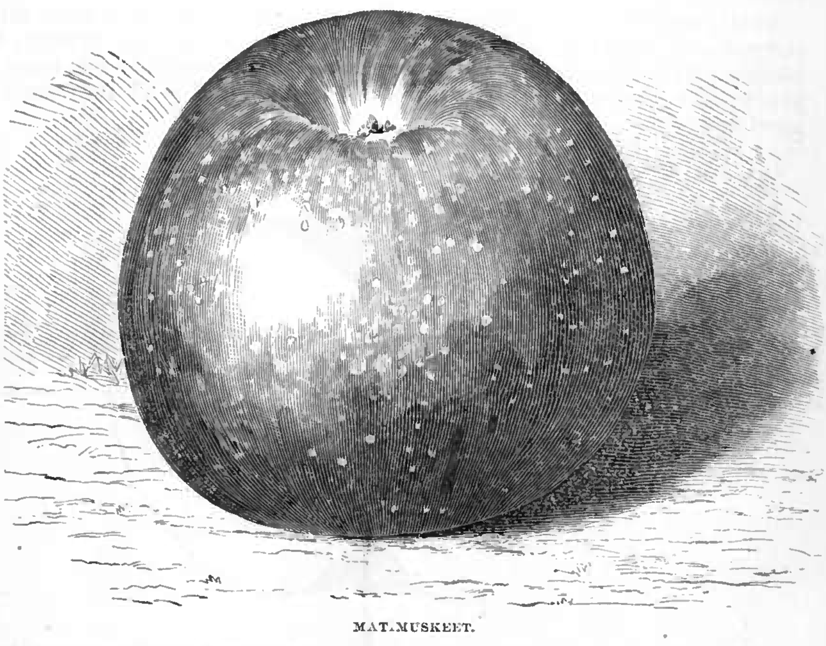
Origin, Matimuskeet Lake, North Corolina; fruit, medium size; form,

PLATE XIV.



CLARKE'S PEARMAIN.

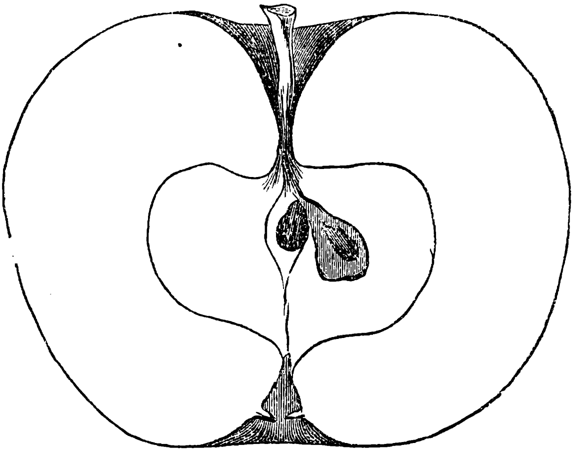
PLATE XV.



MATAMUSKEET.

oblate, often slightly conical, mostly covered with pale dull red on a greenish yellow; flesh, pale yellow, firm, fine, juicy, slightly acid, and very good; keeps till May and June; tree, upright in growth, very productive; the best keeping high flavored apple in North Carolina and the South.

NICKAJACK.



Synonyms: Caroline, Berry, Summerour, Accidental, Red Pippin, Howard, Hubbard, Mobbs, Cheataw, Pound, Edward, Shantee, Wall, Aberdeen, Trenham, Big Hill, Carolina Spice, Cheatan Pippin, Chatham Pippin, Wander, Winter Rose, Red Hazel, Forsythe's Seedling, Ruckman's Red, Alleghany, Chaltram Pippin, Gowden, Graham's Red Warrior, Walb, Winter Horse, Missouri Pippin, Missouri Red, Leanham, Jackson Red, World's Wonder. (Downing.)

Originated in Western North Carolina; fruit, large; form, roundish, oblate, and somewhat conic; color, greenish yellow, much striped with dull red; flesh, rich, juicy, and very good; ripens during winter till March and April; specimen under average size, from a tree growing on poor ridge; tree, of large, strong, but irregular growth and when on deep, rich soil yields well, and produces fine marketable fruit.

GILPIN.

Synonyms: Carthouse, Roman Knight, Small Romanite, Gray Romanite, Little Romanite. (Downing.)

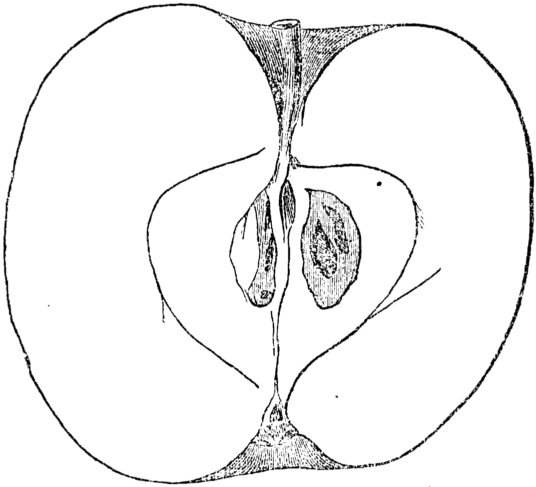
Fruit, medium size; form, roundish, flattened; color, streaked with red and yellow; flesh, yellow, firm, juicy, and rich; keeps till May; tree, of straggling growth when young.

WINESAP.

Fruit, medium size; form, roundish, rather oblong; color, deep dark red on a greenish-yellow ground; flesh, yellowish, crisp, tender, and high flavored; keeps until April; tree, of good, though of rather irregular, growth; a valuable variety in the South.

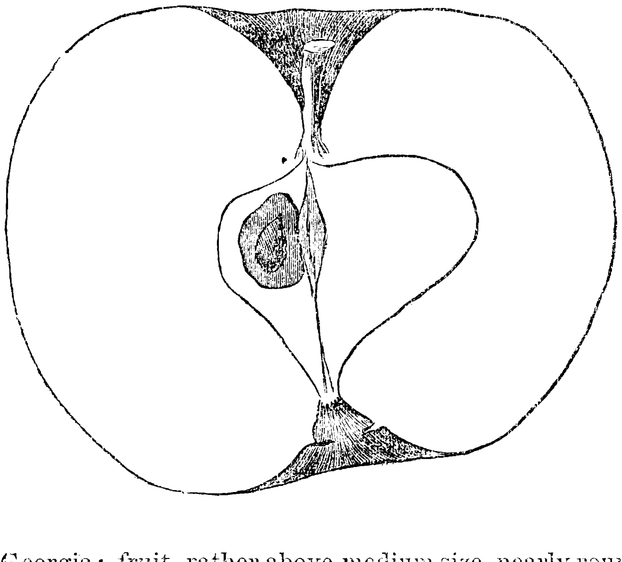
13

AUNT PEGGIE.



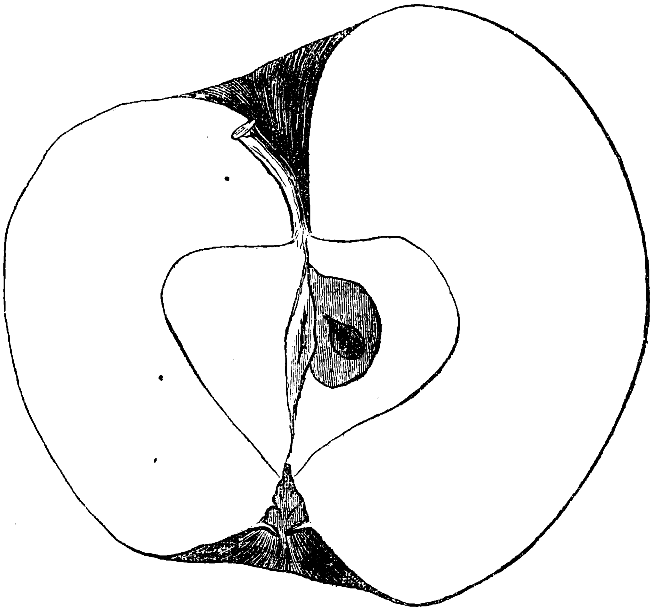
Origin, Guilford County, North Carolina; fruit, medium size; form, roundish, conical, inclining to oblong; color, greenish yellow, striped with red; flesh, white, fine flavored, very good; keeps until late spring; tree, fine growth, and bears regularly and well.

DISHAROON.



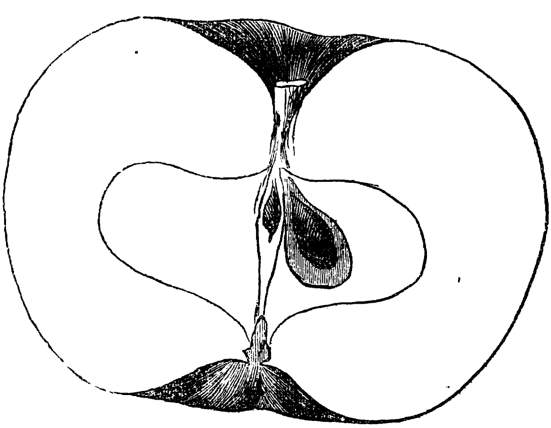
Origin, Georgia; fruit, rather above medium size, nearly round; color, pale green; flesh, yellowish, tender, juicy, and of an excellent, mild, somewhat acid flavor; ripens from middle to end of autumn; tree, of thrifty growth, and an abundant bearer.

WINTER HORSE.



Of uncertain southern origin; fruit, medium to large; form, roundish oblate, sometimes rather conical, irregular; color, clear, pale yellow, when ripe; flesh, rich, juicy, and of pleasant flavor; keeps well through winter; tree, moderately vigorous; fruits very early.

SHARPE'S GREENING.



Origin, North Carolina; fruit, medium size; form, oblate; color, yellow;

flesh, of fine quality; keeps till a late period in spring; tree, of irregular and rather slender growth.

CULLASAGA.

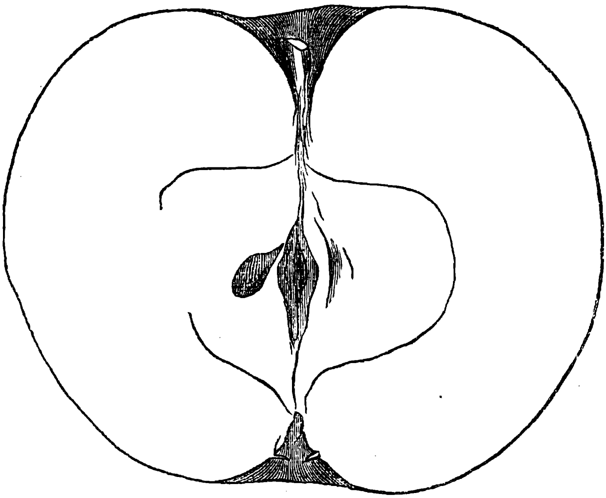
Origin, North Carolina; fruit, above medium size; form, roundish, ather conical; color, yellow, mostly covered with light crimson dots; flesh yellow, firm, rich, juicy, and fine flavored; keeps until March; tree, good grower, and good bearer.

BEN DAVIS.

Synonyms: New York Pippin, Victoria Pippin, Victoria Red, Kentucky Pippin, Baltimore Red, Carolina Red Streak, Funkhouser. (Downing.)

Fruit, large size; form, roundish, somewhat conical; color, yellow ground, beautifully striped with bright red; flesh white, tender, juicy, with a mild sub-acid flavor; keeps till April; a good market variety.

FERDINAND.

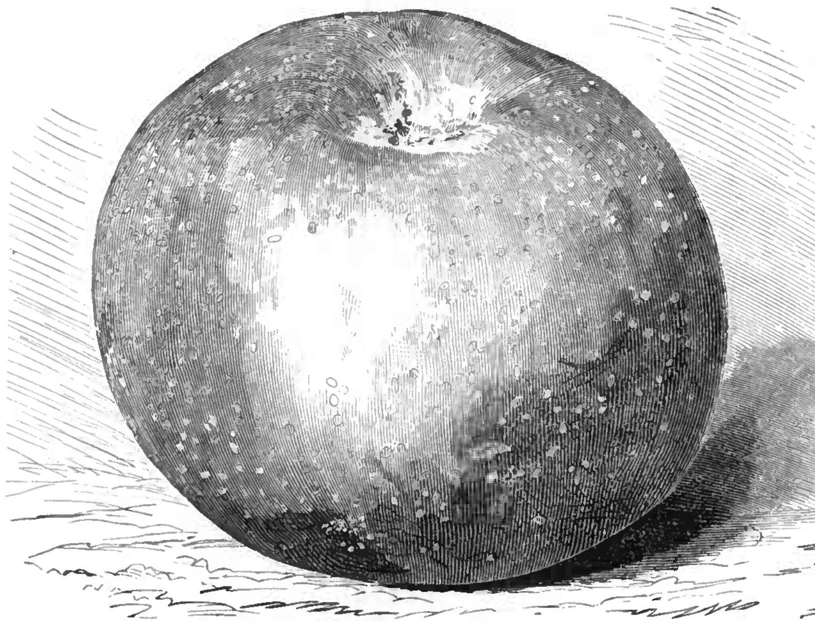


Fruit, large; form, somewhat conic; color, yellow, sprinkled with brown dots; flesh, yellow, tender, slightly acid; keeps till April.

HEMPHILL.

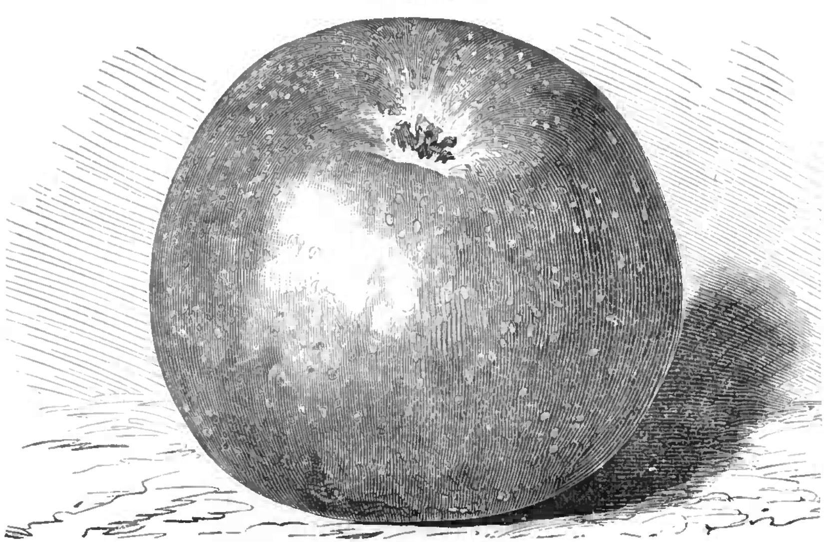
Origin, North Carolina; fruit, above medium; form, roundish, slightly conic; color, pale yellow, shaded with red, and sprinkled with gray dots; flesh, yellowish, solid, and very rich; keeps till April; tree, of vigorous, upright growth.

PLATE XVI.



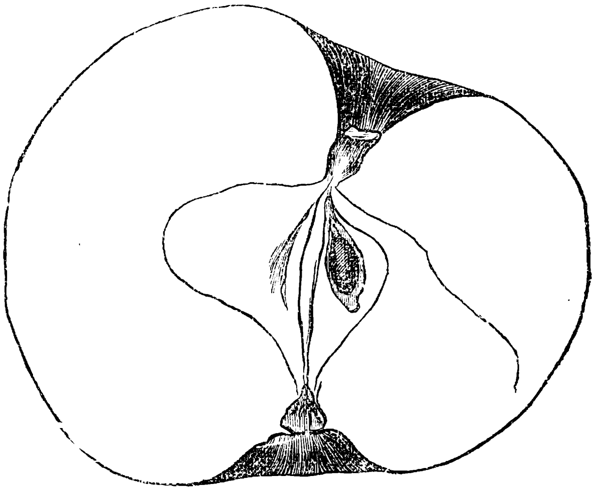
NICKAJACK.

PLATE XVII.



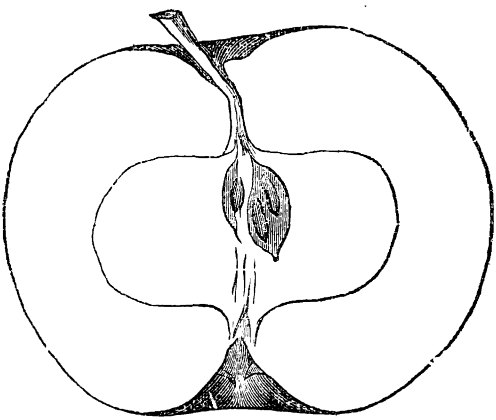
GREEN CHEESE.

GUILFORD RED.



Origin, Guilford County, North Carolina; fruit, medium; form, roundish conical, sometimes rather oblong, irregular; color, fine red; flesh, rich, pleasant, and fine flavored; very good; keeps well throughout the winter.

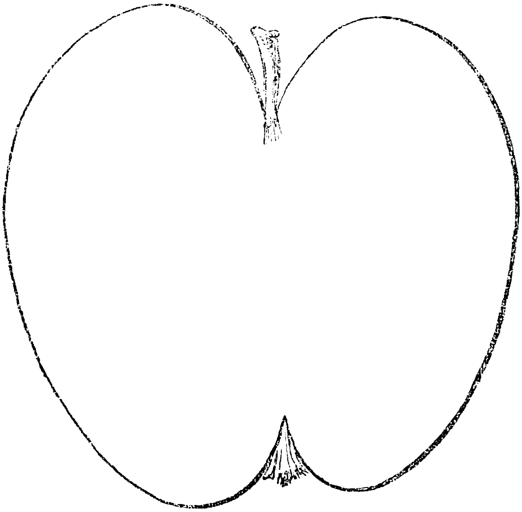
GREEN CHEESE.



Synonyms: Green Crank, Southern Golden Pippin, Green Skin, Yellow Crank, Winter Greening, Winter Cheese, Carolina Greening, Turner's Cheese. (Downing.)

Fruit, medium; form, oblate; color, greenish yellow, thickly sprinkled with brown dots; flesh, yellowish white, tender, juicy, slightly acid, and flavor good; keeps until April.

GULLY.



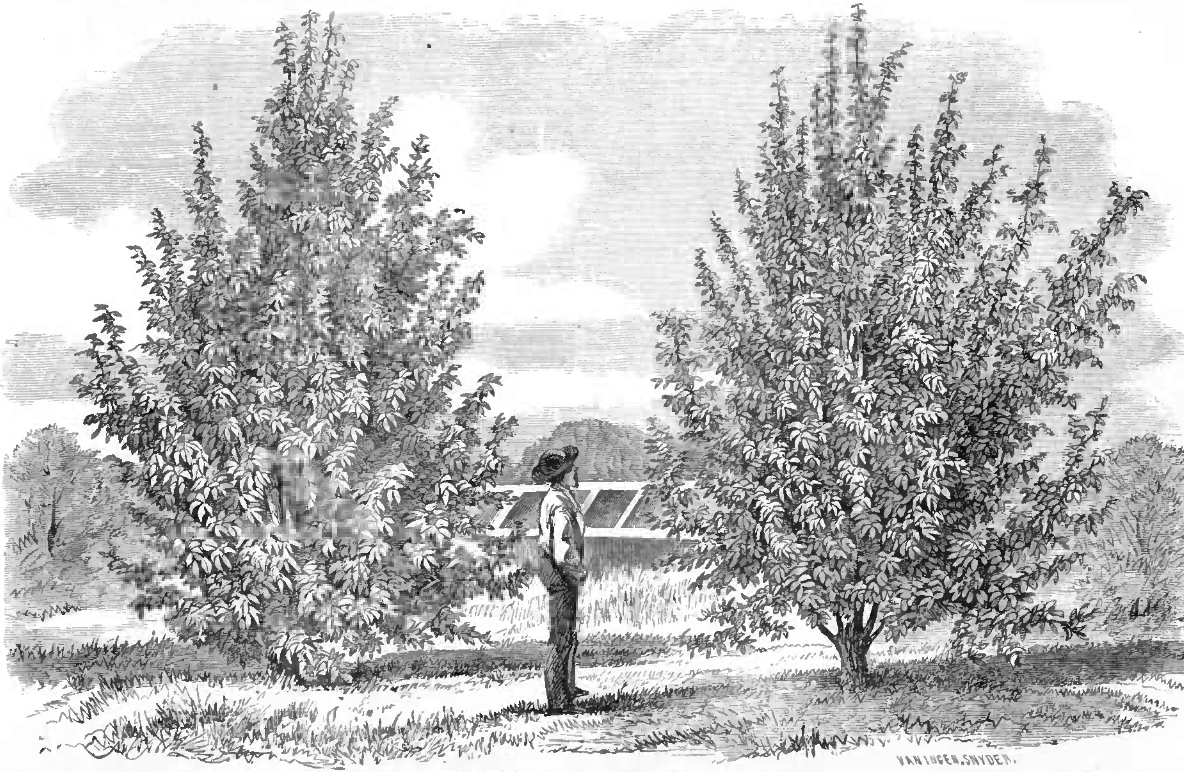
Origin, Granville County, North Carolina; fruit, medium size; form, oblong; color, pale yellow, nearly covered with lively red, thinly sprinkled with gray dots; flesh, rich, tender, juicy, sub-acid; keeps till April; tree, of vigorous, upright growth, valued where known.

REMARKS ON PEAR CULTURE.

The value of the pear, as a domestic fruit, is second only to that of the apple. For culinary purposes the latter is probably more highly esteemed, but for the dessert the pear is almost universally held as much superior. The pear tree is hardy, and attains to a great age, greater, it is conceded, than the apple, notwithstanding the popular impression that it is subject to more casualties, and is not so enduring. History proves that the pear is of very ancient cultivation, although it has not been so largely or so generally planted as the apple; various reasons may have influenced this discrimination, the most prominent of which are the greater care required in harvesting the crop, and the difficulty of keeping and ripening the fruit to its highest degree of perfection. Even at the present time the management of the finest winter varieties is far from being generally understood. The prevailing opinion that the tree is constitutionally tender, and more subject to diseases and casualties than other fruit trees, has undoubtedly exerted a strong influence against its extended culture; but, however much these reasons may have gained credence in the past, they have now lost their efficacy, and many extensive pear orchards have been planted during the past fifteen years, and their number is constantly increasing.

SITES, AND SHELTER OF PEAR ORCHARDS.

Low situations should be avoided on account of the greater extremes of temperature prevalent in valleys than in places of moderate



PEAR TREES EIGHT YEARS FROM THE BUD.

PLATE XVIII.

elevation, and the consequent probability of injury from late spring and early winter frosts. A sloping hillside, contiguous to a well-defined valley, forms the choicest orchard site, not only for pears, but for other fruits as well. To insure the greatest advantage from position the trees should not be planted lower than within fifty feet of upright elevation from the lowest point in the valley. The cold air will then settle during the night, in a stratum below the trees, and the warm air accumulated in the lower ground during the day will be pressed up to the higher altitude occupied by the orchard, and thus afford considerable protection in cold nights.

The obvious necessity of shelter to pear orchards has led, in some instances, to the mistake of selecting low grounds for their apparently well-protected position; which, for the reasons given above, are the worst possible localities. Contrasted with valley planting, even what might be termed bleak exposures have the preference, and the unsatisfactory results attending orchards in low protected grounds has led to a supposition that shelter is injurious rather than beneficial.

The addition of shelter to an otherwise judiciously selected site is altogether different from endeavoring to secure it by choosing a low situation. The efficacy of protection is now generally well understood, especially by those who attempt pear culture in regions that are comparatively treeless. Even the White Doyenne, the famed Virgalieu, or butter pear, worthless in exposed situations, is produced in all its pristine excellence where the tree is protected, as may be seen in many old gardens in cities, where this variety is very common.

The shelter required is not so much to repel or alleviate mere thermometric cold, as it is to arrest evaporation and its accompanying exhaustion of vitality, by checking the rapid and penetrating action of dry winds.

Evergreen trees afford the most perfect shelter in the least space. A single row of Norway firs, Austrian pines, or other equally hardy evergreen trees will give shelter for a considerable distance; thickly planted belts of deciduous trees will also render effective service. How far apart these belts and hedges should be placed, and in what direction they will be most useful, will depend upon the surroundings and local specialties. As the best mode of draining a field will depend upon its surface undulations, so the best mode of sheltering will be guided by the general aspect and position of the orchard.

SOIL.

The pear will exist in a variety of soils, but attains greatest perfection in clayey loam. Even on stiff clays the tree will grow and produce very satisfactorily under the ameliorating influences of the preparation and culture which such soils require. Draining first and subsoiling afterwards are the chief requisites for gradual amelioration; in short, while a water-soaked clay soil is the most utterly worthless of all lands for the growth of any crop, a properly drained and aerated clay soil is by far the most valuable, and only requires careful management to render it available for the best productions of the orchard, farm, or garden The prominent precaution in managing a clay soil is never to work on it while wet, but only when it is dry to friability. No expedient or process of culture will compensate for the injury sustained by working clay soils during summer, when they are saturated with water; the injury cannot be remedied except by a winter's freezing, which will again produce friability, under proper treatment.

Soils of a sandy or gravelly character are not well adapted to the pear. In these soils, so variable in their degree of moisture, the trees ripen prematurely and drop their foliage early, if the weather proves dry towards the end of summer; then, in the event of moist weather following a period of drought, a late secondary growth will be produced, which, failing to mature, induces a tendency to blight, and predisposes to other diseases. Surface dressings of compost, repeated cultivation, or constant mulching, will counteract, to some extent, the effects of uncongenial soil for the pear roots, but where it is impracticable to select any but a thin gravel or sand for the growth of this fruit, the dwarf tree is preferable, as the roots of the quince can be confined to a small area, which may be prepared and maintained to meet all the requirements of growth.

PLANTING.

Where the soil has been prepared by deep tillage it will not be necessary to dig holes deeper than required to merely cover the roots of the plant. In heavy soils that have not been prepared in the most thorough manner the holes should be made wide rather than deep. In gravelly subsoils pits may be dug eighteen inches in depth, the surface soil and the subsoil being thrown out at opposite sides, and filled in equally until the proper height is reached for setting the plant. In either case about a bushel of compost, made up of leaf mould, rotted manure, and light soil, if carefully spread around the roots, will form an admirable rooting medium; this should be finely pulverized and rather dry than wet when used.

Deep planting and shallow planting are the injurious extremes in setting trees. The plain and incontrovertible rule is to set the plant so that the point from whence the stem and roots proceed in opposite directions will be about one inch below the level of the surface of the ground. It is infinitely better to plant so that some future surface dressing may be required to cover the swelling exposed roots, than to have them buried below the ready influence of atmospheric heat and air.

MULCHING.

The preservation of a proper degree of moisture in the soil surrounding the roots of the tree is the principal object of culture during the first summer after planting. Both the kind and amount of care will depend upon the nature of the soil and the condition of the weather; something will also depend upon the first preparation of the ground. Where the soil has been drained, deepened, and pulverized, and the surface is loose and mellow, nothing further will be required than merely to prevent a growth of weeds. If the surface is tenacious, frequent stirring, especially after rains, will probably suffice, but where the soil is shallow and largely composed of sand or gavel, mulching will most effectually accomplish the purpose.

Any loose material will answer as a mulch, such as coarse manure, strawy litter of any kind, or short grass as cut from lawns; where a few trees only are to be cared for, tan bark and refuse charcoal dust are frequently employed. Mulch should not be applied before the middle of June, unless the weather proves very dry and warm previous to that time, and on clean ground it may remain during the following winter, or be renewed if exhausted; but in rough, soddy ground, where field mice may lurk, the soil around the trees should be thoroughly comminuted, and kept clean and compressed.

CULTURE.

The best mode of treating the soil in pear orchards is an important question both in regard to the health of the tree, and the production of fruit. Laying aside all special circumstances, it appears evident that the condition of the plants will indicate the treatment required; the object being to maintain health and encourage fruitfulness, the measure of successful accomplishment of these conditions will greatly depend upon the knowledge of the principles governing vegetable growth possessed by the cultivator. When the trees are young the chief object is to encourage judicious growth, by employing expedients known to favor vegetable extension, such as the application of manures, breaking up and pulverizing the soil, surface stirring, and other similar operations. By *judicious* growth is meant a luxuriance not incompatible with maturity, and as this will depend upon climate and locality, it is evident that a discriminating knowledge of cause and effect will largely influence success. In northern latitudes where the season of growth is confined to five months duration, it will be impossible to mature the same amount of wood that can be produced on trees in a locality having seven months of growing season. In the latter case stimulating appliances may be used with the best effects that would only tend to dissolution in the climate of short summers. The great desideratum in fruit culture is ripened wood; all useful cultivation begins and ends with this single object in view, and is the criterion of good or bad management.

To cultivate, or not to cultivate, is a question to be determined by climate and condition of soil. Where it is deemed advisable to encourage growth, it will be proper to employ such appliances of culture as are known to produce that result; and again, when ample luxuriance is secured, and the tendency is still in that direction, all surface culture should be abandoned, and the orchard be laid down in grass, cultivation to be again practiced when the trees indicate its necessity.

PRUNING.

The pear tree is usually a victim of excessive pruning. It is pruned in winter to make it grow, and pruned and pinched in summer to make it fruit. Why it is that the pear, more than other spur-bearing fruit trees should be supposed to require so close and continued pruning does not appear of easy explanation. It is evident that this immoderate pruning is not followed by satisfactory results, for while apple, plum, and cherry trees fruit with abundant regularity, with but little attention to pruning, unfruitfulness in the pear is a frequent cause of complaint, especially with those who pay the strictest attention to pruning rules, showing clearly that sucessful pear culture is not dependent upon pruning alone. While it is perhaps equally erroneous to assert that pear trees should not be pruned at all—an extreme which no experienced cultivator will indorse—it is worthy of inquiry whether unpruned trees do not exhibit a better fruit-bearing record than those which have been subject to the highest pruning codes. How far the proverbial liability of the pear to suffer from blight may be due to the interference and disarrangement of growths caused by summer pruning it may not be possible to decide, but the tendency to late fall growths, and the consequent immaturity of wood which is thereby encouraged, is well known to be of much injury, and greatly conducive to disease. Perhaps no advice that has been given is so fruitful a cause of failure and disappointment in fruit culture as that embodied in the brief sentence, "Prune in summer for fruit."

The physiological principle upon which this advice is based is that which recognizes barrenness in fruit trees as the result of an undue amount of wood growth, and that, in accordance with acknowledged laws, any process that will secure a reduction of growth will induce fruitfulness. The removal of foliage from a tree in active growth will weaken its vitality, by causing a corresponding check to the extension of roots, but the removal of the mere points of strong shoots has no palpable effect in checking root growth, the roots proceed to grow, and the sap seeks outlets in other channels, forming new shoots, which in no way increase the fruitfulness of the plant.

While it may be confidently stated that, as a practical rule, easily followed, and of general application, summer pruning for fruit cannot be recommended except as an expedient rarely successful, it is also true that there are certain periods in the growth of a plant when the removal of a portion of the shoots would tend to increase the development of the remaining buds, without causing them to form shoots. For example, if the growing shoots of a pear tree are shortened or pruned by removing one-third of their length, say, toward the end of June, the check will immediately cause the remaining buds on these shoots to push into growth and produce a mass of twigs as far removed as may be from fruit-producing branches. Again, if this pruning is delayed until August, and the season subsequently proves to be warm and dry, the probabilities are that the remaining buds will develop into short spur-like shoots, from which blossom buds may in course of time be formed; but if the season continues wet, and mild and growing weather extends late into the fall, these same shoots will be lengthened into weakly, slender growths, which never mature, and are of no use whatever. There is no certainty as to the proper time to summer prune, because no two seasons are precisely alike, and trees vary in their vigor from year to year; and yet this uncertain, indefinite, and constantly experimental proceedure is the basis upon which the advice to "prune in summer for fruit" is founded.

The pear tree, in fact, requires very little pruning, and that only so far as may be necessary to regulate branches in either of two exigencies. In the first place, when the young tree is placed in its permanent position in the orchard, its roots will be greatly disturbed and many of them destroyed; it will therefore be expedient in this exigency to abridge the branches, so as to restore the balance of growth that existed between the roots and branches previous to removal.

This pruning at transplanting has its opponents on the theoretical grounds that, as the formation of roots is dependent upon the action of leaves, it must follow that the more branches and leaves left upon a plant the more rapidly will new roots be produced; but there is one important element overlooked in this reasoning, namely, the loss of sap by evaporation, which speedily exhausts the plant, while it has no active roots to meet the demand. The proper practice is to reduce the branches so as to give the roots the preponderance, and many kinds of trees can only be successfully removed by cutting the stem off close to the ground.

If the tree has been pruned close back at planting, the first summer will develop the foundation for a well-balanced, symmetrical plant, but as this result depends upon a good start, it is well to keep an eye on the young growths during the first season, and if any of the shoots appear to be developing to the detriment of others equally necessary for future branches, the points of such shoots should be pinched off, but in doing so, let there be as small a removal of foliage as possible, the object being not to weaken, but merely to equalize growth. As a general rule no

advantage will be gained by pruning any portion of the shoots after the first season, unless in the case of weakly trees, which will be strengthened by pruning down during winter. The removal of branches during summer weakens growth, but when a portion of the branches are removed after growth is completed, the roots, not having been disturbed, will have the preponderance, and the number of buds being diminished, those that are left will receive increased vigor.

It should never be forgotten that there is nothing more certain than that by shortening-in or pruning back the ends of shoots, either in summer or winter, the fruit-producing period is retarded, and the fruit-producing capabilities of the trees abridged. Fruiting spurs will not form where the growths are constantly interrupted and excited by pruning;. but, after the third or fourth year, young shoots will, in the majority of varieties, become covered with fruiting spurs the second year after their formation, if left to their natural mode and condition of growth. Of course this refers to trees in soils of moderate fertility, grown in a climate favorable to the plant.

The only pruning, then, that is really essential, after the plant has become established, will be confined to thinning out crowded branches; and this forms the second exigency for pruning. If low-headed trees are preferred, those branches that have become destitute of fruiting spurs near the body of the tree may be cut out and a young shoot be allowed to take the place of the one removed. There will be no lack of young shoots for this purpose, as they will be produced from the base of the cut branch, selecting the strongest and best placed to occupy the vacancy, if such occupancy is desired. This mode of cutting back branches will be more particularly essential in the case of dwarf pears, as the quince roots are unable to support a tall, heavy-headed tree, but in all other respects dwarf pears should be treated the same as standards.

INFLUENCE OF STOCKS ON GROWTH AND QUALITY OF FRUIT.

In comparing remarks and observations made by different cultivators with reference to the merits of varieties, their growth, productiveness, size, and quality of fruit, and other characteristics, there is found so great a disparity as to lead to a supposition that different varieties are being discussed under the same name. No doubt this is occasionally the case, but the difference caused by the influence of the stocks upon which they are worked is frequently to blame for these discrepancies. Every nurseryman is aware of the great irregularity of growth in plants of the same variety; they may have been grafted at the same time on stocks of equal size—planted on the same day and in the same soil, yet their comparative growths will vary considerably; so much difference exists that the plants will be classed into two or more sizes, and held at different valuations. Although the vigor of growth imparted is thus varied, the habit of the variety is not changed, the upright form of growth will still characterize the Buffum, and the spreading habit of the Rostiezer will remain with each individual of that variety; but in a plantation of fifty of any sort there will be some weak growers, and an occasional specimen that, after lingering on in a sickly condition for several years, will finally be removed.

It is reasonable to expect these diversities in the growth of stocks produced from seed, and the influence they impart to the graft, but it is seldom that allowance is made for the many peculiarities that may undoubtedly be traced to this cause. This is still further confirmed by the

more uniform growth of dwarf pears, the stocks of which are produced from cuttings or layers, and are consequently of more uniform vigor, being an extension of one individuality, instead of the separate individualities of seedling plants.

BLIGHT.

The greatest drawback to extended pear culture is the disease familiarly known as blight. The predisposing cause of this malady has not been specifically determined; the active cause of dissolution is known to be parasitical fungi. This much, however, experience seems to confirm: that trees placed in positions and under circumstances of soil and climate that insure a growth of moderate vigor, which growth shall become perfectly matured and solidified before the advent of winter, are so seldom attacked by this disease as to be, for all practical purposes, exempt.

A safe practice, and one that will probably become general when further and extended experiments prove its value, is to cover the body of the tree and all the principal branches, but not the buds, with a wash, formed by placing one peck of lime and two pounds of sulphur in a vessel, and adding sufficient boiling water to slack the lime. If the white color is objectionable it can be changed to any other more suitable. The spread of fungi on the bark of trees has been arrested by timely application of this mixture.

DISTANCES APART FOR PEAR TREES.

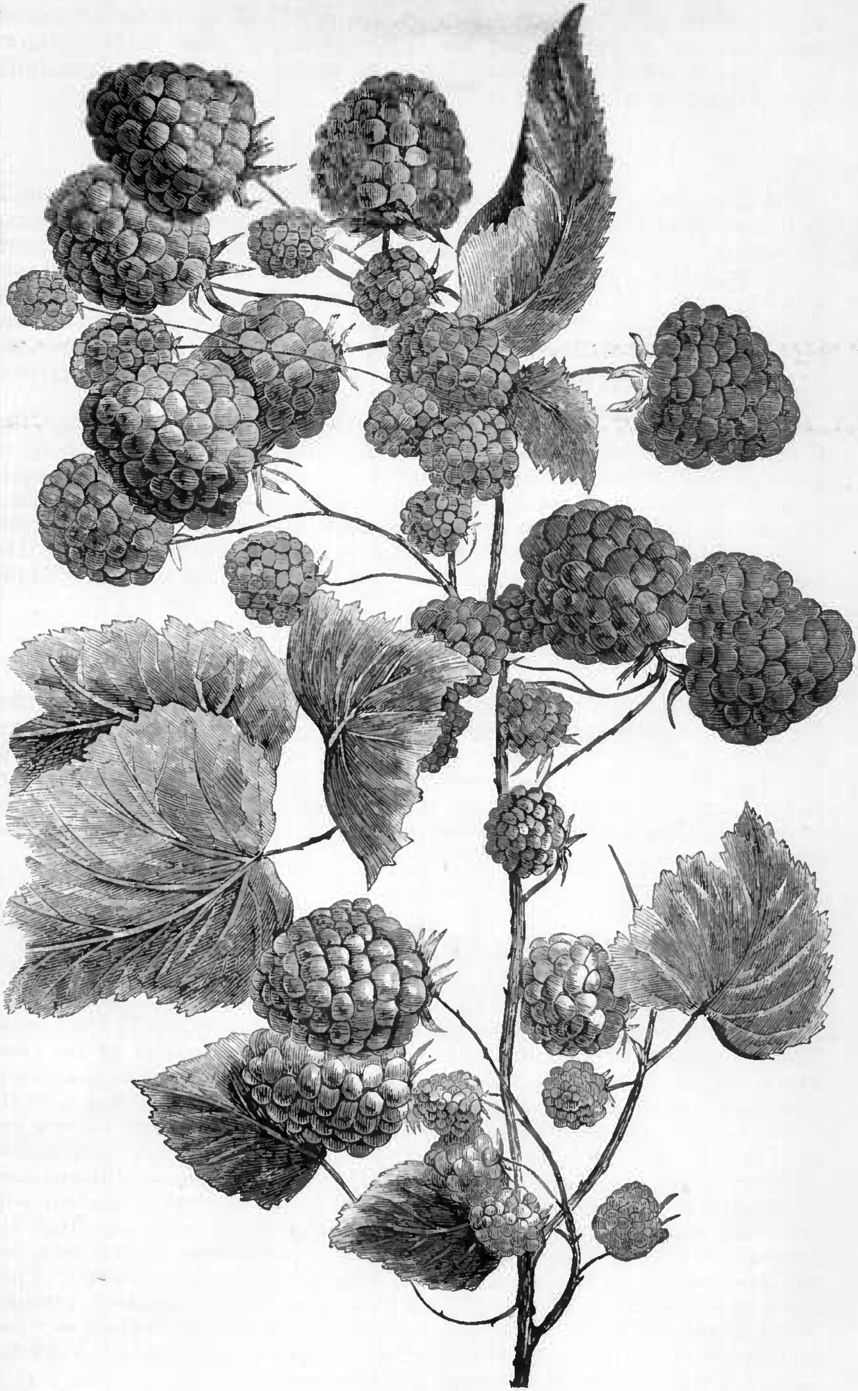
The opinion is now becoming prevalent that close planting, so that the trees shelter each other, is advantageous. For standard trees, eighteen feet apart is considered a good maximum, and ten feet for dwarfs. These distances preclude the practicability of using horse-power in the culture of the soil, at all events after a few years' growth; which, all things being considered, may be regarded as a step in the right direction.

THE CRANBERRY INTEREST.

The American cranberry (*Vaccinium macrocarpon*, Gray) is found in a wild state in boggy land throughout the northern portions of the United States, in parts of Canada adjacent, both on the marshes of the coast and the glades of the Alleghanies, as far south as Virginia and North Carolina. It is also found in South America. The plant belongs to the heath family, and is a small, hardy shrub, with evergreen leaves, and acid, edible fruit, varying in color from light, dull pink to a dark purple. Wherever the cranberry grows naturally it indicates the conditions most favorable to its production by choosing locations well supplied with moisture, and a pure peaty, or sometimes silicious soil, free from any mixture of clay. Peat is most favorable to luxuriance of the vine, but the presence of silex also, in considerable quantity, is necessary to produce that condition of the plant which insures the greatest productiveness and the finest fruit, as it hardens the wood, prevents too vigorous growth of vines, and discourages the growth of weeds. Very fine crops, however, have been raised on pure peat.

The limits between which this fruit may be successfully cultivated are

PLATE XIX.



HERSTINE.

A new seedling Raspberry, a cross between the Allen and the Philadelphia.

PLATE XX.

SAUNDERS.

A new seedling Raspberry, a cross between the Allen and the Philadelphia.

stated by an intelligent observer to be the thirty-ninth and forty-second degrees of latitude; but the limit may be greatly extended southward in the Alleghanian ranges, and at least thirteen degrees northward on the western coast of the continent, owing to the ameliorating influence of ocean currents upon the climate of that coast; and we find that cranberries grow in abundance upon the large island of Kodiak, south of and adjacent to Alaska, and of as good quality as those cultivated upon Cape Cod.

The cultivation of the cranberry commenced in the early part of the present century, and until twenty or twenty-five years ago was conducted upon a very limited scale. The first culture was in the vicinity of Cape Cod, Massachusetts, and subsequent experience has resulted in increased productiveness and improvement of the plant.

VARIETIES.

There are several varieties of the cranberry now cultivated, among which are the Bell, Cherry, and Bugle, so called on account of form or color. Another variety, recently noticed by Mr. Trowbridge, of Milford, Connecticut, is by him called the Mansfield Creeper. Of the varieties best known, the Bell and the large Cherry are the favorites among growers. The Mansfield Creeper is described as suitable for upland culture, and its fruit is of large size.

THE BEST SOIL FOR CRANBERRIES.

Observation shows that the cranberry usually chooses a peaty, or a silicious, moist soil; and continuous success in its cultivation has been achieved upon such soils only. Professor Agassiz says:

> Never use the drift formation in preparing cranberry grounds. Use silicious sand that has been entirely separated from loam by the action of water.

A writer in a recent number of the American Agriculturist asserts that the plant is at home only in sand, peat, and water. An observant cranberry grower of New Jersey says:

> Experience has proved that for the successful cultivation of this fruit the following are requisites: first, a peat, or muck soil, free from loam or clay; second, clean beach sand for covering the peat; third, a dam and water to overflow the vines when necessary; fourth, thorough drainage.

These conclusions are warranted by the experience of cranberry growers generally; and while, in very favorable locations as to climate, the winter flooding for the protection of the vines may be omitted, and while it is true that some have succeeded in raising good crops upon pure peat, and also upon sand, still these variations from the foregoing rules are at the great risk of the cultivator, and should not be practiced except after careful experiment.

LOCATION AND AREA OF CULTIVATED CRANBERRY LANDS.

There are cultivated cranberry fields in Maine, Massachusetts, Connecticut, and New Jersey. In Maine, near Augusta, Kennebec County, the cultivation has been commenced, but on a limited scale. The acreage is small, and not reported. Except upon the sea-coast, where the rigor of the climate is modified by sea breezes, this crop seems to be attended with much risk from frost, unless grown in fields which can be readily flooded. The same remark applies to Massachusetts,

with some modification. In the latter State cultivation of the cranberry is confined mostly to the counties of Barnstable and Plymouth, and is most profitable in Barnstable County on account of its favorable situation. Only about one hundred acres of land have been brought into cultivation as cranberry fields in the vicinity of Kingston, Plymouth County, in the last fifteen years, and the entire area so cultivated in Massachusetts is estimated at less than two thousand acres. In Connecticut there are only twenty acres of these lands, situated in the counties of Middlesex and Tolland. In New Jersey much energy, care, and money have been devoted to this culture, and within a few years it has assumed considerable importance, and is steadily increasing.

LOCATION OF WILD CRANBERRY LANDS.

Cranberries grow wild along the coast of Maine, in marshy soils, and on interior bogs; on similar lands in Massachusetts and Connecticut; along the eastern shore of Lake Champlain, in northern Vermont, and on adjacent land in Canada; on boggy lands throughout the northern portion of New York; on similar soil in New Jersey; to some extent in Virginia and North Carolina; on the glade lands of the Alleghanian plateaus; extensively in favorable locations in northern Ohio, Michigan, Wisconsin, Illinois, Indiana, Minnesota, and Iowa; and in Oregon, Washington Territory, and as far north and west as Alaska and the Aleutian Islands; in some of the latter being extra in size and quality, and growing abundantly.

ANNUAL PRODUCTION.

The aggregate annual product of cranberries in the United States can only be roughly estimated. It is variable according to the seasons, but that of the cultivated berry is increasing. In New Jersey, especially, where so much attention is now given to the cultivation of small fruits, hundreds of acres of land are being redeemed each year from a primitive, unproductive condition, and devoted to cranberry culture; and that State now supplies two-thirds of the total amount marketed, of both wild and cultivated, and over three-fourths of the whole amount of cultivated berries. Recent careful estimates give the following amounts of cranberries marketed in 1869: Maine produced 1,000 barrels; Massachusetts, 8,000; Connecticut, 2,000; New Jersey, 50,000. This amount of 61,000 barrels was derived principally from cultivated fields. At nineteen stations on the La Crosse northern division of the St. Paul and Milwaukee railroad, 14,585 barrels were freighted during the berry season of 1869, only 3,220 barrels having been freighted from the same stations in the season of 1868. From other portions of the West, including the Pacific coast and from other producing regions, no special reports have been received. A recent California paper states that there is quite an extensive trade carried on between San Francisco and Oregon in this fruit. It will be safe to estimate the products of other States and localities, not estimated above, at 20,000 barrels; making a total production marketed in 1869 of at least 75,000 barrels, worth, at the average price of $11 per barrel, $825,000. The crop of 1867 was estimated at 62,500 barrels, of which New Jersey produced 35,000, New England about 12,000, and the West 15,500 barrels. The average price of 1867 was $16 per barrel, giving a total value of $1,000,000. The vines were more prolific in 1869 than in 1867.

INSECTS INJURIOUS TO THE VINE AND FRUIT.

The cranberry has suffered both in fruit and vine from the ravages of insects, sometimes to the extent of a total denuding of the vines of their leaves and the loss of entire crops. It is to protect the vines and fruit against these, as well as against the effect of frost upon the unripe berries, that flooding is regarded as necessary by experienced growers. Inquiries into the natural history of these insects are of very recent date, and information upon the subject is meager. The larva of the *Anchylopera vaccineana* feeds upon the foliage. According to the statement of William C. Fish, a naturalist employed by the Cape Cod Cranberry Association to make investigations, it hatches about the 20th of May, in Massachusetts, from eggs which have remained upon the vine during the winter, and again, about the 4th of July, a second crop appears from eggs laid in June. The eggs are a flat, circular scale, of a honey-yellow color, and are deposited on the under side of the leaves. The fruit worm, hitherto supposed to belong to the same family as the vine worm above named, is said by Mr. Fish to belong to a distinct species. It is of a yellowish-green color, and enters berry after berry, eating the inside of each, and finally goes into the ground to spin its cocoon and change to a chrysalis state, unlike the vine worm, which spins its cocoon among the leaves at the end of the vine, drawing two together for this purpose.

The larva of an insect called *Pristiphora identidem* has also been discovered by Mr. Fish to be destructive to the vine on Cape Cod, though the insect is not numerous. The perfect insect is called a saw-fly, having a toothed ovipositor with which she makes a slit in the leaves, depositing an egg within. Broods of this species appear in June and August.

There is a small, reddish-brown beetle, *Anthonomus suturalis*, numerous about the middle of July, which selects blossoms just before they are ready to expand, and deposits in them an egg through a hole made in the center of the bud by its mouth or snout. The beetle usually cuts off the bud after depositing its egg. A dull white grub hatches from the egg and feeds within the bud, changing to a pupa and then to a perfect beetle and eats its way out, leaving a round hole in the side of the bud. The beetles sometimes, though seldom, feed upon the berry. They are never seen upon bogs flooded in winter. The larvæ are killed by a minute *Chalcis* fly.

A small, soft insect, with legs, but without wings, is also found about the 8th of June in little masses of froth upon growing shoots of the cranberry vine and blueberry bush. The froth is sap from the plant, sucked in and then exuded by the young larvæ, probably for concealment. This insect is the *Clastoptera proteus* of Fitch, and belongs to the sub-order *Hemiptera*, having no jaws, but a beak through which it sucks the sap of the plant. The perfect insect jumps with the agility of the flea. It is not usually numerous enough to be noticeably injurious, though sometimes sufficiently so to weaken the vines.

About the middle of June small leaves at the tip of growing shoots may be found closed together in a manner similar to the work of the vine worm, but without a web. Within will be found a small, orange-colored maggot, white when first hatched, without legs. This maggot spins a cocoon within the small leaves at the end of the shoot, which resembles white tissue paper. After remaining in the cocoon about twelve days the perfect insect, the *Cecidomyia*, or gall gnat, appears. The maggots only work among the minute tender leaves at the end of

young shoots. They have no jaws, and must suck in the sap and moisture through the mouth. They make no excrement. There is a little *Chalcis* fly that is a parasite upon this insect and destroys large numbers. Mr. Fish found the gall gnat upon every bog visited by him in 1869 in Massachusetts.

In addition to several of the insects here spoken of, a caterpillar is noticed which infests the vines at Sandwich, Massachusetts. It is about one and a half inches long, covered with yellow-gray hair, and has longer tufts of darker hair at each end of the body. Mr. Fish says: "It probably belongs to the genus *Arctia* or some of its allies. It was quite numerous, and devoured the leaves of the young, growing shoots, leaving the shoots standing upright and leafless." When full grown they disappeared.

PROFITS OF CRANBERRY CULTURE.

This is a branch of husbandry in which money is easily lost as well as made. Experiments upon a medium or large scale are costly unless the location chosen is peculiarly favored by nature. The ground must be prepared at considerable original expense for grubbing roots and removing turf, leveling, supplying sand, drainage, purchasing and planting the vines, and the erection of dams for flooding. The cost of preparation is seldom less than $200 per acre, and sometimes reaches $600; but when a cranberry field thus prepared has been brought into bearing there is usually but little further expense incurred in its care and cultivation except the moderate cost of securing the annual crop, and the profits are such as attend few other branches of agricultural industry. From reports of the products of nine fields in New Jersey, the average production is found to be 151 bushels per acre; though this result is exceptionally large for an average of years and of crops. Several cranberry growers report that the average production lies between 100 and 200 bushels per acre on well-prepared fields, the limits being 25 and 300 bushels. Others report the average to be 100 bushels, and others still, 125; estimates in different locations being widely different. Taking one year with another, and averaging the production of cultivated fields, wherever reported, probably 100 bushels, or about 35 barrels, per acre are a fair estimate of production from the time when the vines come well into bearing. With good care, well-prepared fields will remain productive many years, some being reported as good as ever after twelve years; and it does not appear that any limit can be fixed to the productiveness of the vines on account of age.

The fact that the consumption of cranberries has steadily increased to such an extent that the fruit, notwithstanding the great increase of production, has advanced in price, and maintained the advance for many years, encourages still greater attention to this branch of fruit culture. The exemption of the fruit from decay after it becomes ripe makes it a reliable market berry, always in season, its preservation extending into portions of the year when it has few competitors among small fruits, insuring a steady and remunerative price. The conditions of its profitable culture, also, are such as to forbid any fear that the market will be overstocked with this fruit, which has become so permanent a favorite.

The following statement, relative to the cranberry interests of New Jersey, is from a correspondent who has been at much pains to obtain local statistics for the use of the Department:

CRANBERRY CULTURE IN NEW JERSEY.

This branch of pomology is of comparatively recent origin, although the cranberry (*Vaccinium macrocarpon*) is a native of the northern and middle States. Until recently the whole supply of this fruit was derived from the comparatively small quantity growing spontaneously in the swamps among the mountains, and from the marshes of South Jersey. While thus growing it was esteemed common property, and, like wild game, was appropriated by the first comer, irrespective of the ownership of the land; yet it was deemed of sufficient importance to claim the protection of the law. As early as 1789 an act was passed by the legislature of New Jersey imposing a penalty of ten shillings a bushel for picking on the unreclaimed marshes before the 10th of October. This was intended to restrain the gathering until the berries should have time to mature. The wild berries were neither so abundant nor so desirable in flavor as the cultivated fruit.

It is singular how little is known of this fruit. The vine, which is creeping and less than a strawberry-runner, like that strikes roots at intervals and sends up a fruit branch from five to ten inches in length, with very small alternate leaves, rather crowded; scarcely larger than the hemlock and evergreen. The blossom appears in May, pale rose colored, on the apex of the slender stalk. The fruit appears in June, and by August has the color and size of a full-grown green currant; and when fully ripe presents a beautiful appearance. The berries are so thick in places that the careless foot must crush several at every step.

There are several varieties of this species, although three predominate: The *cherry*, so called from its round shape; the *pear*, or bell shape; and the *bugle*, or oblong. The color varies from light to dark-red; some are mottled red and white. The darker the color the more valued, as they sell more freely and for better prices.

Cranberries are found indigenous to the soil on the steppes of Russia, and far north both in Asia and America, though the Russian berry (*Vaccinium oxycoccus*) is small and of an austere flavor. Quantities of this were formerly exported to England and France. The English cranberry, which belongs to the same species, is found in a wild state among the marshes and fens of Lincolnshire and elsewhere. The fruit is small, of a pale red color, somewhat acrid, and inferior to the American fruit, both in size and flavor. There are other varieties, but our attention is confined to the *Vaccinium macrocarpon*. This species extends from Maine to the Carolinas. In the former State and in Massachusetts it is principally found in a narrow belt along the shore. Cape Cod and its vicinity produce a large amount of cultivated fruit. The product of New Jersey has entirely outstripped that of the Eastern States, however, though the business here is yet in its infancy, every year adding to the area planted.

It is said that in Massachusetts attempts were made in this culture forty years ago, but they were limited to few cases, and, though successful, did not attract general notice until about twenty years later, when more attention was given to the cultivation, which has increased in that State until a comparatively large portion of the land available for this purpose has been appropriated. In New Jersey, until within ten years perhaps, not more than a half dozen persons were engaged in the business. A few had to some extent improved the natural bogs, and given some attention to planting, but six acres were the extent of any one operation. One of these pioneers, in a period of about eighteen years, during which time he gradually increased his cultivated bogs to ten acres, has realized a fortune of over $100,000, and his success has stimulated others to like effort, until the product in New Jersey greatly exceeds that of any other State.

As might be supposed, the first attempts at cultivation were rude and often on unsound principles, but perseverance in experiment and observation of the nature of the plant have corrected many errors, and the general principles which govern the preparation of the land and the treatment of the vine are to a great extent known and practiced.

The cranberry region of New Jersey is in the southern part of the State, being a belt of land underlaid with white sand, much of it pure silex, the upland covered with pine and oak, the lowland and borders of streams with white cedar, with an undergrowth of whortleberry and like shrubs. The soil is light, a thin coating of vegetable mold covering the surface.

The most important matter to be determined in embarking in this business is the selection of suitable land. There are three kinds of ground used for this purpose. The first is what is called "savanna," being low spots of ground with grass or small bushes, and covered with water during the winter and spring, but becoming dry during the summer. These spots have a thin coating of vegetable mold overlying white sand. The second is a mixture of sand and muck to a depth varying from six to ten inches, underlaid with sand and covered with scanty vegetation, the bottom, or subsoil, being hard sand. The third is a deep muck, usually along a stream affording a growth of white cedar, or sometimes maple trees and bushes.

It is said that swamps where the prevailing trees are gum are unsuited to the

cranberry. They indicate cold spring water, which is inimical to the growth of this plant; it requires pure water, but not too cold. The cranberry is found in every county of South Jersey, yet, as the requisite qualities of sand, muck, and moisture are found combined in but few locations, the breadth of this culture must remain comparatively limited.

The climate, as well as the soil, of South Jersey is congenial to this vine, and adapted to developing the fruit in its highest perfection. The proximity to the ocean modifies the severity of the winter; there is a hoar frost instead of the ice of more northerly climates. This ripens, colors, and perfects the berry, and protracts the harvest season, which continues two or three weeks later than in the New England States. The late frosts in spring and the severe frosts of autumn, which so often tend to shorten the crop in those States, seldom prevail in New Jersey to such an extent as to interfere with the product.

In preparing the land the object is to afford to the plant the elements needed for its successful growth, to give it entire possession of the ground, and to protect the young plant until it attains full vigor, when it is able to maintain itself in health without further attention, and will last for many years.

The mode of preparation of the land varies with the kind of soil. The savanna lands, if covered, as they usually are, with grass, pines, or low bushes, must be cleared and "turfed," that is, the surface sod cut off with a turfing hoe and removed. It is usually carried off on a kind of car made to run on wooden tramways which are light and portable, so that the track may be shifted as required. The sod or turf is placed in a wall or embankment from four to six feet wide and of a height equal to the width. The ground is then plowed, the roots and stumps being removed or burned, when the land is ready for planting. Ditches must be made around the lot inside the walls, with cross ditches at distances varying from 100 to 300 feet, and of a depth (six to twelve inches) depending on the character of the land, so that it may be flowed in winter and in summer and rapidly drained, provided there is a permanent stream of water, which this kind of land seldom has. The black sand land is treated in much the same manner, except that it is usually found on the banks of, or contiguous to, a stream of water by which it may be flowed, and in this and probably in the greater quantity of muck over the sand mainly consists its superiority over the savanna land. There are many abandoned mill ponds which are readily made available for cranberry parks at comparatively small expense, and are much sought, as the dams are already erected and water is abundant.

The other kind of land is the deep muck bottom of cedar or other swamps. This is by far the most expensive kind of ground to prepare, yet when properly prepared it is the most valuable, because of the larger and more certain product, as well as of the more permanent fertility. In moist seasons the sand or savanna ground yields generous crops, but in very dry seasons the amount of fruit is much reduced. The swamps are usually covered with cedars, bushes, and stumps, and, as they are always wet, require thorough drainage, and being soft and miry the labor on them is difficult and tedious. When these incumbrances are removed the whole surface must be covered with a coating of four to eight inches of sand. This is done in the same manner as the turf is removed, in small cars run by hand on the movable railways. The sand is taken from the shores where it usually abounds, and scattered over the muck; when, if properly drained and ditched, it is ready for the vines. The sand is essential, for while the vines will grow luxuriantly on the muck, so will the weeds and grass, and the vines would be smothered and choked; besides, the silex is a necessary ingredient for the health of the plant. Pure white sand is essential. Clay, or even a loamy sand, is inimical to the cranberry, and should be studiously avoided.

The vines are planted in rows two to three feet apart and from twelve to eighteen inches in the row. This is the more usual mode, though the plan varies. Some place the plants eighteen inches apart each way. The planting should be as early in the spring as possible, to secure a good growth.

The cost of preparing and planting varies with the character of the ground. The savanna, which requires simply "turfing," when it is ready for the plow and then for planting, is the least expensive, and it may also be remarked, the least valuable. The cost varies from $150 to $200 per acre. The labor and expense of improving swamp lands are much greater, the amount from the beginning until planting is completed varying from $300 to $400, and in some cases reaching $600 per acre, including ditches and embankments, dams and gates for regulating the flowing. After this there is an expense of $5 to $10 per acre for two or more years, until the ground is wholly coated by vines and the fruiting begins.

Though various methods of treatment for the second and third years have been pursued, experience has demonstrated that the simplest mode is the best. The hoe is rarely needed to eradicate weeds and grass, and its use, or that of the plow and cultivator used by some, is injurious. The weeds and grass are best eradicated by hand pulling, which prevents injury to the roots and the tender running vines. The hoe may be used to level the surface and to make drains from low spots so that there shall

be no stagnant water. Sluices should be made to carry the water off rapidly after flowing or after heavy rains.

The usual time for flowing is from the last of October to the first of May, and eighteen to twenty-four inches of water are sufficient. Some cultivators advise a flow of water for twenty-four hours in the first week of June, when it can be done rapidly and safely. The water is then drawn off, and the plants, under the genial influences of the sun and moisture, are soon covered with the tiny pink-white blossom, and the fruit quickly appears. All that is now needed is to keep a supply of moisture, during the drought of summer, till the harvest calls for more active operations.

There are drawbacks to the results, and enemies to the vine and fruits to be resisted, as with almost all other fruits. First, excess of dryness, especially in savanna fields; second, the vine worm, which commences its ravages in the latter part of June and, if not destroyed in a few days, makes sad havoc with the most promising fields.

The worm is not two inches in length, and in circumference not larger than a fine thread, and so nearly the color of the vines as to escape observation unless the vines are continually examined. The only premonition is the appearance of a vine here and there as if touched by fire; upon closer examination it will be found girdled near the ground and the plant killed. The worm passes from vine to vine, and, if not arrested, the destruction, not only of the fruit, but of the plant, is inevitable. If, when the vines are so attacked, the gates are opened and the ground flooded for twenty-four hours, the surface will be found covered by legions of these worms, and the bogs will be safe for the year. If there is no arrangement for flowing, the bog is at the mercy of this minute but destructive foe. Statements are given of great destruction by these pests. So far, however, the extent of their ravages is quite limited, yet sufficient to put cultivators on their guard.

There is a worm, somewhat resembling the apple worm, which destroys the fruit. It is not as yet very common or formidable, and it is claimed that winter flowing is destructive to this pest. In some places, last year, complaints were made of grasshoppers. These must have been on savanna grounds, as flowing would be equally as destructive to them as to the worms. The injury from these insects is exceptional. Many have had bogs for years without any annoyance from them.

PRODUCT.

The amount of product varies so that it is difficult to fix an average. It chiefly depends on the soil, the care of the young vines, and the ability to flow, and thus to counteract the influences prejudicial to the crop. Some will and should be quite content with 50 bushels per acre. The quantity increases from that amount up to 100, to 200, and even to 400 bushels per acre, the latter yield being confined to a few favored spots. Some claim 150 to 200 bushels as the average per acre of good bogs, but a more careful opinion places it at 100 bushels, and surely this ought to be sufficient to satisfy the most ambitious.

PRICES.

The gross price of this fruit ranges from $3 to $8 per bushel, depending principally upon the quantity in market and the supply of other fruit. The rates for seven years in Philadelphia, according to the market reports, have been as follows:

	Per barrel.		Per barrel
October, 1863	$12 15	February, 1864	$15 00
" 1864	11 00	" 1865	14 00
" 1865	14 00	" 1866	15 00
" 1866	15 00	" 1867	16 00
" 1867	16 00	" 1868*	24 00
" 1868	28 00	" 1869	32 00
" 1869	10 00	" 1870	24 00

In 1868 the amount produced was but about half the average yield. The yield in 1869 was largely increased, and as all fruits were unusually abundant they sold low, ranging from $10 to $14 per barrel in the fall, but regularly advanced through the winter until, in February, the rate was $20 to $24 per barrel.

EXPENSES.

The expenses are, picking, at an average of 50 cents per bushel; boxes, 25 cents, and barrels 50 to 80 cents each. To this are added packing, freight, and commission; in the aggregate, $1 30 to $1 60 per bushel, leaving $2 to $3 per bushel as profit.

Thus it will be seen that the profits per acre are from $100 to $300, and even up to $600 in a few exceptional cases. One of the oldest cultivators writes that his bog of ten acres has averaged 225 bushels per acre for eighteen years; last year he gathered

* In February, 1868, they were $35 per barrel in New York.

275 bushels per acre, and the net proceeds were $6,200. This is large, but not without precedent.

RESULTS.

A few results are given from reliable information, omitting names: A lady from one acre realized $1,000 from a single crop. A gentlemen paid $1,000 per acre for eight acres, and the next year gathered 1,000 bushels, valued at $4,000. One person in Burlington County, from twenty acres, realized $6,000. A park of thirty acres produced, in 1868, $10,000, and in eight years $48,000. Another person from twenty-one acres got for his crop $8,000. From a twelve-acre park a gentleman in Ocean County picked 1,900 bushels, netting him $7,000. A seven-acre lot in Burlington County, yielded in 1867, 1,150 bushels, worth $4 per bushel—$4,600; and an adjoining tract of about the same size yielded $3,450. A gentleman in Cape May County has two acres; his crop in 1867 was 750 bushels, worth $2,000; in 1868 the crop was 600 bushels, worth $3,200. A ten-acre lot, near Tom's River, Ocean County, in 1867, produced $5,000; in 1868, 900 bushels, $6,000; in 1869, $5,000—for the three years, $16,000. The owner was offered and refused $2,000 per acre for his lot.

ACREAGE.

The quantity of land under cranberry cultivation in New Jersey is large, and is annually increasing. The county of Ocean has perhaps more cedar swamp and marsh suitable for this business than any other; and while the number of acres under cultivation is great, there is a large body not yet appropriated to this crop. The best estimate that can be drawn makes the number of acres in bearing at least 600, and 1,000 acres more have been planted within three years, and are not yet productive.

The next county in order of acreage suitable for this purpose is Burlington, with a like number in bearing, and an equal amount of product. Atlantic County has upward of 100 acres in bearing, and 500 not yet producing. Then follow Monmouth, Camden, Gloucester, Salem and Cape May, with less acreage, perhaps 400 acres in the aggregate of bearing vines, and 1,000 acres of recent planting.

This makes a total for the State of about 1,800 acres in full bearing, and 4,000 acres not yet producing; and a total product of 150,000 bushels for the year 1869, worth, at $3 per bushel, $450,000.

These amounts, however, are but estimates, as it is difficult to ascertain with any certainty, except in a few townships, the precise amount either of the plants, acreage, or the product.

PICKING CRANBERRIES.

The month of October is the season for gathering the crop. The picking is usually done by women, boys, girls, and men not able to labor as full hands. The price paid is from 40 to 60 cents per bushel. The quantity for a day's work varies from 2 to 4 bushels, according to the abundance of the crop and the skill of the operators. A crop of 1,000 bushels, at an average rate of 3 bushels per day's work, requires 12 pickers for the month. There are often from 50 to 200 engaged on the same marsh. This crop, with the other berry crops of South Jersey, gives employment to many thousands during the greater part of the summer and fall seasons.

In the districts where small fruits are largely cultivated, as in Vineland, Hammonton, and other settlements less extensive, they commence in June with strawberries; from these in about a month they pass to raspberries; then follow blackberries. In August the whortleberry crop commences, when the pickers scatter through the swamps and uplands, where they gather *ad libitum* the whole crop as their own, as was formerly the case with the wild cranberry. When these are gathered, commences the cranberry picking, which extends up to November, and industrious pickers acquire a good return for their summer's work.

It is a pleasing sight to witness one hundred to two hundred men, women, and children engaged in this business. As the pay depends on the quantity gathered, there is much rivalry to secure the largest amount. They operate under the direction of an overseer, who regulates the order of the work, marking out the plots, and keeping tally of the number of bushels, which is designated by tickets handed to the picker for each bushel poured into the boxes placed at the sides of the bog.

PACKING.

After the berries are harvested, they should be overhauled, cleaned, and placed in barrels or boxes for market. The barrels may be sugar and apple barrels, or those made expressly for this purpose. Ninety quarts are considered a barrel. The boxes are made of narrow strips of pine or cedar, with a division in the center, and will contain one or one and one-half bushel each.

Boxes are preferred as they are more easily handled, and from their size and open construction allow a freer ventilation, and thus tend to keep the fruit from heating, thereby preserving it longer and in better condition. Besides this, the boxes are more salable in bulk, a box being for many purchasers a desirable quantity. The fruit thus packed and stored in a cool and dry location will keep for six or eight months in good condition with little loss or shrinkage.

New York, Philadelphia, Boston, and Baltimore are the leading markets, where they are purchased by large dealers, who distribute them throughout the whole country. The domestic trade is continually enlarging, while shipments are made to England, France, and the West Indies, and this foreign demand is increasing.

The question is asked, will the demand be equal to the product from increased quantity of land brought under cultivation, will it be advisable to engage in this busi ness—will it be profitable? The answer to these questions is, under certain qualifications, yes. Past experience shows that good fruits will command large prices, and that the demand, although the quantity has wonderfully increased, has been quite equal to the supply. This fruit, from its quality of remaining so long in perfection without expense or loss, has an additional value, and must be a staple article in this line of product. Probably not one-half of the inhabitants of the United States have ever tasted a cranberry.

While those who are seeking land for this culture should endeavor to secure all the elements of success, and should see that, when prepared and planted, the bog has proper care, individuals may with propriety turn to account, in this business, any land they may have on their farms, although not of the first class, as in this way a few acres may yield more than the product of the remainder of the farm.

Companies should select one hundred to two hundred acres, and this will require the supervision of a competent agent; first to plan the plots, embankments, dams, and ditches; and second, when the planting is done, to cultivate the vines, and especially to attend to the harvesting and marketing of the product. Much depends on the ability and faithfulness of the agent. A bog combining the requisite qualities may be confidently expected to make a large yield and a profit of twenty-five to fifty per cent. from year to year. This is well tested by past experience. Says a large cultivator, "I know of nothing half so profitable."

The reason why this business has not made more rapid progress is the want of easy communication in this part of the State, arising from the sandy roads so general, and the absence of railroads. Now, however, railroads are being made through every part, and the effect is to develop the resources, and to show the peculiar fitness of this soil and its favorable location for the raising of the variety of fruits and vegetables fitted for the markets of Philadelphia and New York.

The advantages which have built up Vineland, Hammonton, and other places, being now enjoyed by large districts hitherto isolated, will give them growth and prosperity, and open up all South Jersey, and in a few years make it the fruit and vegetable garden of the great cities on either side, and the cranberry will be one of its most important products.

THE ONION.

The onion (*Allium cepa*) belongs to the lily family, which includes a large number of bulbous plants widely disseminated over the earth, but principally confined to the temperate zones. Its exact habitat is unknown On the Eastern continent it grows in its greatest perfection in the warm countries of Egypt, Spain, and Portugal; but in the United States it is found to succeed best in more northern latitudes. In the colder portions of our country it has been found necessary to shorten its season of maturity by originating early and vigorous varieties, and to stimulate them into as rapid and healthy growth as possible; and this may be accomplished by selecting from year to year those onions which mature first, and then sowing their seeds.

VARIETIES.

The first requisite for success in growing onions from the seeds is to get the variety best adapted to the locality in which it is to be culti-

vated, and also seeds of the best quality. A neglect of this care may be regarded as the first cause of failure in cultivating this plant. A variety will never reproduce itself exactly from its seeds, although when it has become "set" by long cultivation and selection it will sometimes reproduce itself for many years with little variation. The onion is governed by the same law in this respect as other plants. Occasionally the differences in color are so great that one variety will be white, another red, yellow, or brown; but the most common variations relate to the shape of the bulbs, some being more cylindrical, more flattened, or more spherical than others. The variation which occasions the most trouble to the cultivator, and requires the most skill and watchfulness to counteract, is the thick neck or scallion, an imperfect form which onions generally have in their wild state, and to which there is a natural tendency to revert. This peculiarity depends principally on this natural tendency to variation, although the character of soil and cultivation have considerable influence. The true remedy for this difficulty must be sought in the selection of the onions to cultivate for seed.

The selection of a variety must depend upon the locality in which it is to be cultivated. For cold climates, in which the seasons are short, and consequently little time is given for maturing the plant, the earliest varieties should be chosen. In warm climates, where the seasons are longer, later varieties may be grown. In New England, especially north of Connecticut, the Yellow Danvers is generally cultivated, and found to succeed best. It is quite early, of good form, fine flavor, though not very tender, keeps well, and is very prolific.

The Large Red Wethersfield is probably more extensively cultivated in this country than any other variety. The globe form is generally preferred to the flat. Although not so early as the latter by about ten days, it is more prolific and better for the market. South of Massachusetts and throughout the great West and the Southern States it is very generally cultivated for the main crop by all those who make onion growing a business. It is said to produce a greater yield, and to keep longer than any other variety. This onion and the Yellow Danvers may be said to be the great market varieties of the United States.

The Yellow Onion, sometimes improperly called the Silver Skin, is cultivated in some localities in the Middle and the Southern States, and is often seen in the markets of Philadelphia and Washington. The Silver Skin, or White Portugal of New England, which has a silvery white skin, like white paper, is cultivated to a considerable extent for the early market, from sets, on account of its pleasant flavor; but, being a poor keeper, it is not grown for the main crop.

BENDING DOWN THE TOPS.

It is sometimes thought that by bending down the tops of the onion two or three inches above the bulbs, or rolling the ground hard before sowing, or keeping it entirely away from the bulbs while growing, will prevent them from becoming scallions; but it is now generally believed by our best onion growers that any mechanical means of this kind have little or no influence in changing the form of the onion from that which nature intended to give it. It is, doubtless, better for the bulbs to grow principally out of the ground, but there is danger in removing the soil, especially when they are small, of letting in the sun upon the tender roots. The seeds are so lightly covered that no danger need be feared that the soil about the onion will interfere with the forming of the bulb. There is, however, advantage in rolling or pressing the ground slightly after

the seeds have been sown, thus preventing it from drying on the surface, or being blown from the seeds, which might retard or entirely prevent their germination.

RAISING SEEDS.

To keep a variety from deterioration by running to scallions, or becoming imperfect in the shape of the bulb, or too late, the largest and most perfect bulbs should be selected annually for seed. The qualities most to be desired are early maturity, thin necks, and tops that wither down to the surface of the bulbs, thus avoiding late growing onions, and the scallion form as much as possible. By persistence in this course from year to year, early varieties or late, globular forms or flat, may be produced at pleasure.

The onions thus selected for seed should be planted in drills three feet apart, in well-manured land, in early spring, the distance between the onions in the drill being eight to twelve inches. They should be covered so as to leave the neck about half an inch below the surface, and the ground be pressed gently around them. A stake should be set by the side of each to which the stalks must be tied for support. If different varieties are cultivated, they should be set in separate plats, at least twenty rods distant, to prevent cross-breeding and the consequent deterioration of the varieties. No attendance is necessary, except to draw a little earth around the bulbs, to keep them clear of weeds, and to keep the stalks securely tied to the stakes. Care should be taken in hoeing and tying not to bruise the stalks.

As soon as the seed capsules begin to turn brown and show signs of opening, the heads may be cut off about six inches below the top of the stalks and tied up in small bunches, or spread on a floor or lattice-work in a dry or airy place till dry enough to be beaten out, after which the seeds should be cleaned and put in small bags or boxes, and be kept in a dry and moderately cool place till wanted for use.

WHAT SEEDS SHOULD BE SOWN.

Only the newest and freshest seeds should be sown. Experienced cultivators of the onion say that the seeds will not retain the power of vigorous growth more than one year. A vigorous plant can be grown only from a healthy seed; hence the necessity of sowing seeds of the previous year's growth. Their germinating power should always be tested before sowing. This may be done by planting a few in a hot-bed, or in a box of earth kept in a moderately cool room in the house. If only a short time is allowed, they may be placed in moistened cotton or moss, in which they will begin to grow in three or four days if of good quality.

The largest and heaviest seeds generally produce the best and largest onions, and should be carefully separated by a sieve from the small ones before sowing. Their weight may be tested by immersion in water and drying them in the sun as soon as possible. The light seeds will rise to the surface, and the heavy ones, fit for sowing, will sink to the bottom.

These principles are of fundamental importance, and, if adopted and practiced from year to year, will prevent, in a great measure, the deterioration of varieties, which is so much complained of and frequently so little understood.

THE SOIL.

New land is not favorable to the growth of the onion. It should be cultivated at least two years with some other crop, as corn followed by

potatoes or carrots. If a proper amount of manure is applied yearly the onion may be cultivated many years on the same land with decided advantage. B. J. Munro, of Bristol, Rhode Island, says one lot of land in that town is known to have been cultivated with the onion seventy-one years in succession. In Scotland a piece has been cultivated one hundred years without any diminution of the crop.

Soils are scarcely ever rich enough, naturally, for this plant, and hence liberal quantities of manure must be applied. Too much is very rarely used—generally too little. The same piece of land that will produce four or five hundred bushels of onions by common manuring, may be made to yield eight or nine hundred bushels by a generous dressing with the materials which the nature of the plant requires for rapid growth. This principle is of the first importance, and if a man will not manure his ground highly he need not expect to become a successful onion grower.

ORGANIC ELEMENTS OF THE ONION.

"The bulb," says a distinguished chemist, "contains much sugar, gum, and mucilage; a considerable quantity of albumen, and other protein compounds, and an acrid, volatile, essential oil, which may be obtained by distilling onions with water. This volatile oil is distinguished from other essential oils by a most penetrating smell, and by a large proportion of sulphur, which enters into the composition. Few essential oils contain sulphur, and the essential oils of onions, of garlics, and of mustard, which all contain much sulphur, thus differ from most others, which consist generally of carbon and hydrogen, or carbon, hydrogen, and oxygen."

The composition of these organic elements may be seen in the following statement:

	Sugar.	Gum.	Mucilage.	Albumen.
Carbon	42.1	42.3	42.9	53.5 and nitrogen 15.5
Hydrogen	6.4	6.9	5.1	7.0 and phosphorus.. 0.4
Oxygen	51.5	50.8	52.0	22.0 and sulphur 1.6
	100.0	100.0	100.0	100.0

Protein is a white, flocculent substance, very similar in composition to albumen, but the exact proportions of its elements are not known. The composition of the essential oil of the onion consists, by weight, of about six parts of carbon, five parts of hydrogen, and largely of sulphur, but the parts of the latter have not yet been determined.

It will be seen that carbon, oxygen, and nitrogen are found in large quantities, and therefore must form an important part of the different manures employed in its cultivation.

J. F. W. Johnston has ascertained, by chemical analysis, that the bulb, when dried, contains 25 to 30 per cent. of gluten, or albuminous matter, which causes it to rank with the pea and bean in its highly nutritious qualities. According to the best medical authority it increases the appetite, promotes digestion when taken in moderate quantities, and is often used with good effect in colds and dropsical affections.

INORGANIC ELEMENTS.

"When burned," says Dr. T. Richardson, "the bulb of the onion leaves an ash amounting to 0.46 per cent. of the weight of the bulb in its nat-

ural state, or 8.80 per cent. calculated dry. The stalk of the plant in its natural state leaves 0.84 per cent., and when dried at 212° Fahrenheit, 9.35 per cent. of ash."

If we suppose the ashes to be divided into 100 parts, the following table will show the number of parts of the different substances which compose the whole:

	Bulb.	Stalk.		Bulb.	Stalk.
Potash	32.35	13.98	Sulphuric acid	8.34	10.50
Soda	8.04	14.43	Silica	3.04	19.77
Magnesia	2.70	Trace.	Phosphate of iron	12.29	10.61
Lime	12.66	25.10	Chloride of sodium	4.49	Trace.
Phosphoric acid	15.09	....			

It will be seen that forty-five parts, or nearly one-half, of the ashes of the bulb are potash and lime, and twenty-seven parts contain phosphoric acid. Only four parts contain chloride of sodium, or common salt. A soil, therefore, best adapted to the growth of the onion, must contain not only carbon, oxygen, and nitrogen, which are found in abundance in the organic parts of the bulb, but also large quantities of potash, lime, and phosphates, which are contained in the ashes, or inorganic parts. These substances must be supplied by manures when not found in sufficient quantities in the soil.

MANURES.

The manures most commonly employed in cultivating the onion are cow manure, horse manure, hog manure, night soil, poudrette,* guano, bones, wood ashes, and sea-weed. Their composition is as follows:

	Cow manure.	Horse manure.	Hog manure.	Night soil.	
Carbon	39.8	38.6	38.7	Water	73.3
Hydrogen	4.7	5.0	4.8	Albumen	.9
Oxygen	35.5	36.4	32.5	Bile	.9
Nitrogen	2.6	2.7	3.4	Animal matters	16.7
Salts and other earths	17.4	17.3	20.6	Salts	1.2
				Undecomposed food	7.0
	100.0	100.0	100.0		100.0

A review of the elementary constituents of the organic and the inorganic substances of the onion shows that carbon, oxygen, nitrogen, potash, lime, and phosphorus form the principal parts. Carbon and oxygen are found in nearly equal proportions in the different manures commonly employed, and they are also furnished in so large quantities from the air—much larger than from the earth—that, although they form by far the largest part of the plant, the effects of the different manures abounding in these substances are not so obvious as those containing other elements not so uniformly distributed. The value of manures is estimated principally by the quantity of nitrogen and phosphates they contain; because they enter largely into the composition of plants in general, and are not so commonly found in large quantities in the earth as carbon and oxygen.

Peruvian guano contains the largest amount of nitrogen and phosphates of any of the manures in the list, and night soil ranks next.

* Poudrette is night-soil dried and mixed with charcoal to remove its odor.

Consequently they are the most powerful fertilizers. Hen manure is similar in its composition to guano, and may be used with good results. Wood ashes contain great quantities of lime and potash, which enter largely into the onion, and, on this account, and because they help to decompose the organic substances in the earth and to liberate carbonic acid, are excellent manures. Bones contain about fifty per cent. of phosphate of lime and forty-three per cent. of animal matter, which abounds in nitrogen, and when ground to a fine powder make a powerful fertilizer for the onion. Sea-weed also contains phosphates in considerable quantity, and makes an excellent fertilizer, where applied in a decomposed state, or after having been burned to ashes. Horse manure contains more nitrogen and phosphates than cow manure, and is regarded by many growers as better for the onion; but, unless it is kept from heating, by keeping it cool and wet, or by mixing it with soil or cow manure, the nitrogen is expelled in the form of ammonia, and it becomes almost worthless. Cow manure contains all the elements necessary for the growth of the onion, and good crops can be raised from this manure alone; but the earthy portions are so small in quantity that an extra crop cannot be grown in common or primitive soils without the addition of some other manure, as wood ashes, guano, bone dust, &c., which contain large quantities of phosphates, potash, nitrogen, and sulphur, which form so large a part of the onion. Hog manure ranks next to night soil in the amount of nitrogen and phosphates which it contains, and is consequently much superior to cow or horse manure for plants which are large feeders like the onion.

About 4.5 per cent. of the ashes of the bulb of the onion, or one part in two hundred and fifty of the whole bulb, are chloride of sodium or common salt, a very small quantity, indeed, but yet necessary to the perfect growth of the plant. If enough is not found in the soil naturally, a little should be added, having been so finely ground that it will mix uniformly with every part of the ground to which it is applied. Some good onion growers have recommended three bushels to an acre, or a little more than a pint to a square rod. This would certainly be a great abundance; perhaps two and a half bushels to the acre would be better.

KIND AND QUANTITY OF MANURE.

The manure used in the culture of the onion should always be thoroughly decomposed. Green manures are not at all adapted to its nature. They do not act quick enough. The kind to be employed and the quantity applied to an acre must depend upon the composition and condition of the soil selected. If the soil is of primitive origin, like that of New England, having been formed principally from the disintegration of granite and gneiss rocks, manures containing lime, potash, and phosphates, in part, at least, would be much more necessary than on the alluvial soils of the prairies, and fertile river banks of the Western States, in which these substances abound, having been derived from the decomposition of limestone, shell, and bones, which form the principal part of it. Indeed, in some parts of these States, the carbonates, sulphates, and phosphates abound to such an extent that onions of the best quality and in large quantities can be grown without any manure at all. In Egypt, so famous in ancient times for its excellent onions, they have been cultivated from time immemorial in a similar soil, formed by the annual inundations of the Nile, and are among the best in the world.

For common soils which have been cultivated two years with some other crop, as they always should be, and are in a condition to produce

fifty bushels of corn to an acre, eight, ten, or twelve cords of fine cow or horse manure, without other fertilizers, will be required to insure a good crop. Some cultivators apply twenty-five cords of cow or horse manure to an acre, when the onions are grown from bulbs or sets, and require much forcing for the early market. If hog manure or night soil is used, a less quantity may be applied in proportion to its value as compared with cow manure, which is taken as the standard.

APPLICATION OF MANURES.

Stable manures should be applied in the fall by spreading evenly upon the surface, and be plowed in to the depth of seven or eight inches, the soil at the same time being loosened three or four inches deeper by subsoiling, if it can be conveniently done. Many advantages are gained by fall plowing. The soil is pulverized by the frosts of winter, and dries sooner in spring, and can, therefore, be worked much earlier in the season, which is a very important consideration, especially when cultivating the onion from the seed. The larvae of insects which have concealed themselves in the ground, and, if undisturbed, would come forth in a perfect state at the approach of spring and injure the young crop, will be destroyed. The manure is also more thoroughly incorporated with the soil; and the liquid portions, which are separated by the rains, are absorbed, and kept in store for the nourishment of the delicate roots of the plants, as soon as they strike into the earth in early spring.

The ground should be plowed again in the spring about five inches deep, as early as it can be properly worked, and the fertilizers for top dressing, as ashes, guano, poudrette, bone dust, phosphates, &c., afterward applied to the surface and carefully harrowed in. Four or five inches of the surface should always be made much richer than that below. Nothing more is necessary in preparing the ground for sowing the seeds, except to remove all stones and clods, and to rake smooth.

ANNUAL CULTIVATION FROM THE SEEDS.

The time of sowing the seeds of the onion is of the first importance, and a neglect to sow them early may be regarded as another cause of failure in its cultivation. The onion requires a long season for its growth, and the cool and moist weather of spring is the most favorable time for it to take firm root, and get a good start before the approach of the hot and dry weather of summer. If this opportunity is neglected, no subsequent culture, however careful, will make up for it, and perfect bulbs will not be formed. Whether at the north or the south, the rule is to sow as early in the spring as the ground is dry enough to be worked. When once the seeds have sprouted, they will not afterward be injured by the cold or frost.

The seeds, if good, should be sown about one-third of an inch apart, in drills fourteen inches asunder, and covered half an inch deep. Four pounds of seeds are required for an acre. When the onions are five or six inches high, they need to be thinned out to an inch and a half or two inches apart. If they are crowded no injury will be done, as they will readily turn upon their sides and grow abundantly large. If, however, it is desired to raise very large onions, without regard to quantity, more

space should be given them. An experienced onion-grower gives the following direction for thinning:

Thin to one inch, if the ground is very rich; if medium, to two inches; if poor, to three inches. One inch may seem to make near neighbors, but the writer has practiced this plan on first-class soil, and found that the onions grow quite large enough. I have had them yield five bushels to a square rod for several rods together.

The sowing can be done better and much more expeditiously with a machine than by hand. Some of these seed-sowers will make two drills at once, sow the seeds very evenly, and cover them at the same time. If the machine is not constructed to perform the covering, it may be done by running a small roller, or shoving a hoe lengthwise along the drills. A trial of the seed-sower may be made before sowing by adjusting the slides and running it over a clean floor, where the seeds may be seen and their proper distance ascertained. After sowing the seeds the ground should be rolled lightly to prevent the surface from drying, thus hastening the germination of the seeds.

HOEING.

Hoeing must commence as soon as the rows of onions can be seen, and before the weeds get any start. This early hoeing is indispensable to success. It should be continued through the season at intervals of about two weeks, or often enough to keep the ground so clean that no weed can ever be seen upon it. And after the onions have been gathered, no weeds should be allowed to grow, since they will exhaust the soil, and deposit their seeds to the injury of next year's crop. This work is now generally performed with a machine. Some machines are constructed with a hoe and rakes, adjusted in such a way that they will cut up all the weeds between the rows, and loosen the ground sufficiently on the surface. The weeds between the onions in the drills may be re moved by hand; or a common wooden rake run lightly and obliquely across the rows, when the onions are out of the double, will generally remove the weeds, and break up the thin crust of the surface sufficiently One man, with a good machine, can keep two acres free from weeds with out extra exertion.

When a machine cannot be had, a hand-hoe, if properly constructed, may be used with considerable success. The best form of a hoe of this kind, for perfect and expeditious hoeing, may be made by taking a piece of steel plate ten inches long and two wide, making both edges sharp by grinding upon the upper surface, that the lower may be perfectly flat, and then riveting it to the ends of the two prongs of an iron shank, the prongs having been bent in such a way that when the shank is put into the handle, and the handle held in the position most convenient for hoeing, the hoe will be perfectly flat on the surface of the ground. It should be kept sharp, and run along flat, backward and forward, between the rows, just below the surface of the ground. With such an instrument, a man will hoe half an acre to an acre a day.

HARVESTING AND STORING.

The proper time to harvest onions is when the tops have turned to a brown or yellow color, and fallen down. In the middle and the northern States, this usually takes place in the latter part of August, or in September. They should be pulled by hand or with a wooden rake, and then allowed to remain on the ground three or four days to dry. After they are dried, if large quantities are to be stored, they may be

thrown into piles containing two or three bushels, and left in this condition two or three weeks, covering them with caps in case of rain. They should then be opened and allowed to dry two or three days before storing.

After cutting off the tops about an inch from the bulb the latter may be taken to bins in the store-house or cellar, and kept for market or for winter use. In latitudes south of New York, they may be kept in bins, in chambers, or on lofts, piled a foot deep, and covered a foot and a half deep with straw or hay, and filled in about the sides of the bins, where spaces should be left, to the same thickness. They should not be disturbed till wanted to market in the spring. Any freezing is an injury, but a little freezing will not injure them materially, if they are not permitted to thaw till the freezing season is past. In latitudes north of this line they must, as a general rule, be kept in bins in the cellar. The cellar should be dry, airy, and cool, but not cold enough to freeze.

Bins may be made in the form of shoal boxes, raised about a foot above the bottom of the cellar, and placed, if desired, one above another at the same distance apart. The size may vary according to the quantity to be stored. Four feet wide and ten inches deep, the length varying according to circumstances, will make a very convenient bin. The bottom and sides may be made of strips of board four inches wide, nailed so as to leave a space of an inch between them. This will allow a free circulation of air, which will remove all moisture and prevent rotting. When the cellar is not perfectly dry or not well ventilated, the windows should be opened for a short time, during warm days in winter. If only a small quantity is to be stored, and there is not time to prepare a bin as directed, they may be put in barrels, with inch holes bored in the sides from the bottom to the top, so that air may circulate through them. Onions preserved by these methods may be kept in the northern States till May.

GROWING THE SMALL BULBS.

The bulbs or sets for biennial culture are grown by sowing the seeds thickly in drills in the spring, as in the annual mode, on very poor soil, and sometimes in a shady place, in order that they may not attain a size larger than peas before the end of the season. The seeds are also sown in some places, as at the North, in the middle of August, on soil as commonly prepared for onions, and by the close of the season they will be about the proper size for re-setting the next spring. The bulb must be pulled and dried; and after cutting off the tops at an inch or more from the bulb, depending upon their dryness, stored in a barn or loft in layers of three or five inches and covered with hay a foot or more thick. If the climate is cold enough to freeze them, they may be put in the cellar in bins, as directed for mature onions, only with the space between the boards narrower. They should be examined occasionally; and, if found damp or wet, should be stirred up carefully, that the air may have access and dry up the moisture.

RESETTING AND MATURING THE BULBS.

In the spring, as soon as the ground can be properly worked, the bulbs should be reset in drills fourteen inches apart, and about three inches between the bulbs. The soil is prepared in the same manner as in the annual cultivation, unless the onions are to be forced in their growth for the market, when it must be made extremely rich. They

should be set deep enough to enable them to retain their position in the ground, the bulb being covered about half an inch above the upper surface, and the soil lightly rolled. The subsequent culture of hoeing, top-dressing, &c., is the same as employed in the annual cultivation. If any of the bulbs throw up seed-stalks, the stalks should be cut off close to the bulb as soon as they begin to bulge; if cut off before this, they are liable to grow again and destroy the bulb. Onions raised in this way are as good as when matured the first year from the seeds; and when grown for the winter or spring market are pulled, dried, and stored in the manner described for the annual cultivation.

THE POTATO ONION.

This singular plant is a variety of the common onion, and produces neither flower-stalks nor seeds. Its bulbs grow just below the surface of the ground, somewhat after the manner of the potato, and from this peculiarity it derives its name *Allium cepa*, var. *tuberosum*, or potato onion. The place of its origin is not known. It is said, by some authors, to have originated in Egypt, but it is first known to have been cultivated in the south of Scotland. The manner in which it originated may be explained on the principle of variation of species. Some species are so much changed by cultivation and climate as to render them incapable of producing seeds, as in this variety.

The preparation of the soil, mode of culture, and storing both the small and the mature bulbs are the same as has been described for other onions. When a full-grown or mature bulb is set in the ground in the spring, it grows and divides usually into five or six, sometimes even twelve, small bulbs, which at the close of the season commonly attain the size of hazel nuts, or one-half or three-fourths of an inch in diameter. In very rich alluvial soils some frequently grow quite large, and may be sold in the market, or used for the table. The small tubers are preserved through the winter and reset the next spring. In southern latitudes, where they are not injured by the frost, they are sometimes reset in October. At the end of the season they arrive at their full size, which is about the same as the common varieties, from two and a half to three inches in diameter.

The large or mature onions, from which it is desired to raise the small bulbs for cultivation the next year, should be set out yearly in early spring by themselves in sufficient quantity to afford an ample supply for planting the next season. They may be set six to eight inches apart, in drills fifteen inches from one another, and covered as directed for onions for raising seed. The small bulbs which are produced from these large ones must be removed from the ground at the close of the season, and reset the next spring about three inches apart, in drills fourteen inches asunder, and cultivated as previously directed for other kinds, except that the earth should not be so much removed from the bulbs. Care should be taken to divide the small bulbs before setting, so that none may be double.

These onions are more hardy than those raised from the seeds, and are rarely attacked by the onion fly. They are, therefore, well adapted to cold climates with short seasons, and to places infested with the onion fly. They are easily raised, a very sure crop, and well fitted for garden culture and family use. Peter Henderson says:

> They are the mildest of all onions, and, though not generally grown for market, are perhaps the best of all for family use.

Mr. Hayward, of Rochester, New York, who has cultivated them extensively, says:

> They are an excellent variety for table use, good keepers, and, what is still better, a very profitable crop.

In some parts of the country they are cultivated largely as the best onion for the early market. In Bristol, Rhode Island, 20,000 bushels were raised this year for that purpose, 400 bushels being sometimes grown upon an acre. The small bulbs for resetting are frequently sold in the market, and are worth $5 to $10 per bushel.

THE TOP ONION.

The top onion is another variety of the common onion, and is called the *Allium cepa*, var. *proliferum*, from the fact that it produces perfect offspring, or bulbs, on the flower stalks. The stalks bear flowers, but, instead of developing seeds in them like most other plants, a cluster of small onions is produced, varying in number from five or six to thirty, and in size from half an inch to an inch diameter.

This variety is propagated entirely from top bulbs, and, like the potato onion, requires two years to mature the crop. To raise the small top tubers for the cultivation of the main crop the next year, large onions which have matured in the ground by the growth of one year are planted in April in northern climates, and in October in the southern, being set six or eight inches apart, in drills fifteen inches asunder, and covered and cultivated in the same manner as directed for seed onions. At the end of the season the tops of the flower stalks will be covered with an abundance of small bulbs fit to be reset the next spring. In southern climates, if the large bulbs from which a crop of top onions has been raised are allowed to remain in the ground through the winter, they will yield a new supply of small bulbs the next season, and continue to do so for a succession of years if manured and properly cultivated, the old bulbs renewing themselves by offsets yearly. In northern climates they must be removed from the ground at the end of the season, and, being kept dry and from freezing through the winter, be reset in the spring. The old bulbs can be used with advantage only for a few years, when new ones should be selected from the main crop.

When the stalks of onions begin to turn brown, the top bulbs are sufficiently ripe for harvesting. They are then cut from the stalks, and set the next spring about three inches apart, in drills fourteen inches asunder, being covered just below the surface, with the earth pressed gently around them, or rolled with a light roller. By the end of the season they attain their full size, and are of good quality.

From the general testimony of cultivators it is not probable that either this variety or the potato onion will keep quite so well as the common onions; they appear to be a little softer, and more spongy in texture; hence particular care should be taken to store them in a cool, dry, and well-ventilated place.

S. Morgan, of Vermont, who has grown this variety for many years, says:

> Some tell us this kind of onion is tough and strong, but the reason of this is they are left in the ground after they are ripe. Gardeners who have grown them for twenty years write for tubers, and tell me they prefer these onions because they are sweet, tender, and juicy.

He also says that they are never injured by the maggot; that they are very hardy, and, if snow falls on them, it seems only to hasten their growth; that they grow to a large size, some of his own production having been four inches in diameter; that they are prolific, and that six

hundred to a thousand bushels can be raised from one acre by an experienced cultivator.

They are very extensively cultivated about Vevay, in Indiana, for the southern market, and thousands of bushels are shipped from that place annually. They have also more recently been cultivated in the Bermuda Islands and Florida, and shipped north for the first supply of the spring market. The small top bulbs for cultivation are usually sold in our market by seedsmen, and are worth about the same as the potato onion, $5 to $10 per bushel.

DISEASES OF THE ONION.

The onion is subject to few diseases, the fungus or smut being the only one which has caused any serious difficulty in its cultivation in this country. The disease manifests itself in different forms, sometimes appearing in small patches in the axils or on other parts of the leaves, and finally extending and covering considerable portions of the surface with a black smut, similar to that frequently seen on the ears of Indian corn. It is also found on the inside of the hollow leaves, turning the outside to a brown or straw color; and when they are opened they are found often to be filled with a black smut like that just described. It attacks the onions when they are quite small, and by its gradual extension rarely fails to destroy them in a few weeks.

The disease doubtless originates from a debility of the plant, and the fungus, which generally feeds upon decayed matter, being a sequence of debility, only hastens the destruction of the plant, by drinking up and poisoning the nutritious elements of the more healthy adjacent parts. This appears evident from the fact that it occurs most frequently on ground which has been cultivated for a long time with this crop, or where Peruvian guano has been largely used as a manure. John W. Proctor, of Massachusetts, an extensive and successful cultivator of the onion, says:

> I learn from experienced cultivators that the smut is found more extensively on grounds where onions have been grown several years. I have seen half acres together where the proprietor thought it necessary to plant the ground anew with some other crop. This was where guano had been used as the principal fertilizer.

REMEDIES.

A remedy for this disease must be sought by using less manure, or manures which are less stimulating and afford less nitrogen for the fungus to feed upon. Alkaline manures are very destructive to the fungus, and may be resorted to with excellent effect to prevent its ravages. Wood ashes, lime, gypsum, and sea-weed are very efficacious. A moderate quantity of cow manure and a liberal use of alkaline substances have been found to be very good remedies for this disease. The external application of weak solutions, as of lime, or salt, or dusting with sulphur, may have some beneficial effect in destroying the fungus and invigorating the plant; but the true remedy must be sought in preparing the ground with a proper quantity of health-giving manures. Old lands may, in some instances, have to be abandoned for a few years, till the deleterious matter is extracted by other crops, and new ones prepared with manures which will be unfavorable to the fungus and give healthy growth to the onion, even at the sacrifice of enormous and over stimulated crops.

THE ONION FLY.

Another cause of failure in the culture of the onion is the onion fly, (*Anthomyia ceparum.*) It is not indigenous to this country, but has

been introduced from Europe. In that country it has been a great obstacle to the culture of the onion from time immemorial, but its ravages with us are comparatively recent. It bears some resemblance to the common horse-fly, but is rather smaller, more slender in form, more agile in its movements, and the wings are more iridescent. "It is of an ash-grey color, with head silvery, and a rusty black stripe between the eyes, forked at its hind end. The species is particularly distinguished by having a row of black spots along the middle of the abdomen or hind body, which sometimes run into each other, and then form a continuous black stripe. This row of spots is quite distinct in the male, but in the female it is very faint, or is often wholly imperceptible. This fly measures $\frac{22}{100}$ to $\frac{25}{100}$ of an inch in length, the females being usually rather larger than the males. The sexes are readily distinguished from each other by the eyes, which in the male are close together, and so large as to occupy almost the whole surface of the head, while in the female they are widely separated from each other." (Fitch.)

The ovum, or egg, is white and smooth, and may be seen by the naked eye. It resembles the common fly-blow, being of an oval form, $\frac{4}{100}$ of an inch long, and one-fourth as thick.

The fly begins to lay its eggs when the onions are an inch or two high, the time varying with the latitude of the place. In the northern States it begins to lay them in the latter part of May or the first of June, and continues through the season, though principally during June and July. "The eggs are placed upon the onion slightly above the surface of the ground, along the thin edge of the sheath, or white membranous collar, which is formed by the base of the lower leaf clasping around the stalk; and others are crowded into the crevices between the bases of the leaves, slightly above where they issue from their sheath. From two to six or more eggs are usually placed on particular plants here and there through the bed." (Fitch.) Although the fly has an ovipositer, the onion is not punctured, nor are the eggs deposited high up on the green leaves, but at the junction of the sheaths, close to the ground; otherwise the larva or maggot which is hatched from the eggs would not be able to enter the onion, nor find the food best adapted to its nature and growth, as it does not feed on the green leaves, but upon the soft and juicy bulb.

"The larva is shining, dull white, cylindrical, tapering to a point at its forward end, (head;) and, when crawling and elongated, nearly the full length of the body becomes tapering. At the forward end the jaws appear under the skin as a short black stripe. Frequently a pale brown stripe or cloud is perceptible behind the middle of the body, caused by internal alimentary substances. The hind end is cut off abruptly in an oblique direction, forming a flattened surface, on which, slightly above the center, are two elevated dots of a cinnamon-brown color, and around the margin are eight small projecting points, of which the two lowest ones are largest; and a little forward of these, on the under side of the body, are two additional points, like minute feet, by the aid of which the maggot shoves itself forward when crawling." (Fitch.) When mature or of full size it is about five-sixteenths of an inch in length.

The larvæ emerge from the eggs very soon after they are laid; sometimes, or even generally, in twenty-four hours. The time varies, however, with the temperature, being shorter when it is very warm, and larger when it is cooler. When hatched they are very small and tender, scarcely longer than the egg from which they issued. They begin immediately to eat their way down inside of the sheath between the layers of the onion, till they reach the more solid part of the bulb, which they

soon consume, or leave only a thin shell on one side, especially if the onion is small. One small onion is not sufficient food for even a single maggot; and, as there are usually several in the same plant, the onion is quickly devoured, and then an attack is made on the one next to it, if in contact, and if not they separate and work their way through the ground in different directions beneath the surface till they find one, or some of its rootlets, which will guide them to the bulb. If not checked in their progress they will sometimes continue to feed upon the bulbs in this way till a whole row is cut down for several yards.

When the larva has attained its full size, which is accomplished in about two weeks, it ceases to move. The body contracts, becomes a little shortened, and assumes more of an oval form. The outside skin hardens and changes to a dull yellow, and then to a chestnut color, each end being stained with black. It has then completed the first transformation, and is in the pupa state, in which the imperfect fly is inclosed in a kind of brown leathery shell or sack, somewhat similar in appearance to those bodies seen suspended from the eaves of houses, or the roofs of old buildings.

The larvæ hatched in the warm weather assume the pupa state in the onion on which they have fed, or in the slimy earth near it; and, after remaining in this state about two weeks, are transformed into onion flies; and coming forth from the shell in which they have been inclosed begin immediately to deposit their eggs upon the growing crop.

Thus it will be seen that about four weeks are required from the laying of the eggs to the completion of the imago, or perfect insect, two weeks of this time being occupied by the young larvæ in feeding upon the onions, and the remainder in hatching the egg and in the pupa state. As the eggs are laid in succession during the whole season, new larvæ of all sizes, and new broods of flies are constantly appearing.

All the flies hatched during the summer and autumn die at the approach of winter; but the larvæ which are hatched too late in the season to be transformed into flies before cold weather, burrow into the ground, and remain there through the winter in the pupa state. As soon as the weather is warm enough in the following spring the second transformation takes place, and an army of young flies comes forth just in time to commence their depredations on the young onions. In this manner a succession of transformations and depredations is continued from year to year, and the insects go on increasing in number unless some calamity of nature overtakes them, or the skillful hand of the agriculturist employs some means for their destruction.

REMEDIES FOR THE ONION FLY.

Many remedies for preventing the ravages of the onion fly have been recommended, and some have proved beneficial. Several of the most popular are here presented, without indorsement of any as absolute specifics:

1. Put two quarts of tar into a kettle, and pour in six or eight quarts of boiling water, allowing the solution to stand till cool. With this fill a common watering pot, having previously removed the rose and closed the spout with a cork in which a goose quill has been inserted. When the onions are up an inch or two run a stream of the solution along each row in the crevices of the leaves near the ground, and continue the application at intervals of two or three weeks through the season, especially during the first six weeks, since at this time the insect makes its

greatest ravages. As the onions increase in size a larger quantity should be applied.

2. Dissolve one-half pound of nitrate of soda in one gallon of water, and apply by pouring it on the onions along the rows where the fly deposits its eggs, as directed in No. 1, using the solution freely. Repeat at intervals.

3. Scatter nitrate of soda, reduced to an impalpable powder, along the rows of the onion when they first come up, being careful to get it into the crevices of the leaves near the ground. Repeat the application as directed in other remedies.

4. To one gill of water add one-fourth of an ounce of gum-arabic, and dissolve theroughly. Immerse the onion seeds in this solution and pour it off. Then strew the seeds with sulphur and stir until they are coated. Dry in the sun before sowing. When the onions are up an inch or two apply the sulphur again by sifting from a tin box, perforated like a pepper-box. Repeat the application occasionally.

5. Apply Peruvian guano along the rows, scattering it with the hand so as nearly to cover the small onions. It is not only a good remedy against the fly, but the onions grow finely under the treatment.

6. As soon as the onions are up, scatter about one-half peck of charcoal dust or soot on each square rod of ground, and especially on the rows ot onions, in the morning when the dew is on, or after a rain, that it may not be blown away.

7. Immediately after harvesting the onions, burn a heavy coating of brush or straw on the ground, that the surface may be as deeply heated as possible. The heat of the fire destroys any larvæ remaining on the ground, or which have passed into the pupa state to remain through the winter. The ashes are also beneficial in enriching the land.

8. Pour a small stream of boiling water along the rows in the crevices of the leaves, and on the bulbs near the ground. The heat will not injure the plants if the water is not poured too long in one place. It should not be poured on the upper part of the leaves. The heat destroys the eggs and kills the maggots.

9. As soon as any indications of the ravages of the fly are observed, which may be known by the softness and wilting of the leaves, pull up the affected onions, being careful to romove all the bulbs, and a portion of the earth around them, and burn them in the fire to kill the maggots.

10. To one gallon of gas-water add one-half pound of slacked lime, and dilute with two gallons of water. Apply as directed for re nedy No. 1, and repeat the application as often as necessary.

11. For the top and the potato onion : Soak the bulbs forty-eight hours, just before setting, in water saturated with salt. It not only prevents injury from the fly, but hastens their sprouting, and subsequent growth. The salt crystallizes on the onion and between the scales, from which the new leaves issue, and being offensive to the fly or injurious to the larvæ, prevents it from laying its eggs on them.

In a former report of the Department, the following remedies are given:

Mr. Bartlett suggests hot water poured through a small tube along the drills, near the roots of the plants; it seems very probable, however, that, by this remedy, the onions would be cooked as well as the maggots. Tar and water, wood-ashes, lime, powdered charcoal, flour of sulphur, and other sustances have been recommended. The charcoal seems to be the most approved. Mr. Sanborn advises petroleum sprinkled along the rows, or watering with soap-suds and soot or pyroligneous acid. For a fly of similar habits, destructive to the carrot, Curtis recommends

suds and gas-water or gas-tar to prevent the fly from depositing her eggs, and a dressing of lime and salt to kill the maggots. All infested onions should be at once destroyed, to prevent the insect from escaping and depositing her eggs on others.

RECENT FACTS.

Yield.—Samuel W. Church, of Rhode Island, raised from four acres 1,475 bushels of Red Globe Wethersfield onions, and 1,300 bushels of carrots. Average per acre 369 bushels of onions, and 325 bushels of carrots. Manured with sea-weed and stable manure, twelve cords to the acre. The onions were planted about the first of April, in rows twelve inches apart and hills six inches apart; the carrots about the first of June in every third row, and every other space between the hills of the onions.

Edward Anthony, of Rhode Island, raised 600 bushels of Red Globe Wethersfield onions, and 400 bushels of carrots on one acre. Manured with fifteen hogsheads of scum from the sugar refinery, at two dollars per hogshead, and eight cords of compost of sea-weed and stable manure, at eight dollars per cord.

Benjamin Doty, of Rhode Island, raised on one acre 610 bushels of Red Globe Wethersfield onions, and 400 bushels of carrots. Manured with fifteen cords of sea-weed and stable manure, worth ten dollars per cord.

Allen Mathewson, of Rhode Island, raised on four acres 1,900 bushels of Red Globe Wethersfield onions, and 1,300 bushels of carrots. Average 475 bushels of onions, and 325 bushels of carrots. Manured with a compost of sea-weed and stable manure, mixed in equal quantities, fifteen cords to the acre.

Seth Thayer, of Rhode Island, raised on four acres 2,610 bushels of Red Globe Wethersfield onions and 1,200 bushels of carrots; average, 652 bushels of onions and 300 bushels of carrots per acre. Manured with eight cords of sea-weed and four cords of stable manure to the acre. The land had been under good cultivation two or three years. This is the largest crop known to have been raised in Bristol, taking four acres together.

William Fletcher, of Chelmsford, Massachusetts, raised on six square rods of ground 50 bushels of Danvers onions; yield at the rate of 1,333 bushels per acre. Land manured with one-third cord of horse manure, and had been cultivated in onions for eighteen years.

J. A. Birchard, of Iowa, raised from thirteen acres 8,658 bushels of Large Red Wethersfield onions. The best two acres yielded 807 bushels per acre, and the next two 800 each. The whole field averaged 666 bushels to the acre. Manured with hog and barn-yard manure, plowed under in the fall, and top dressed with ashes, after the onions were sown; the ground was made rich enough to produce 100 bushels of corn to the acre.

Henry Percy, of New York, raised 360 bushels of the large Wethersfield onions on half an acre. Manured with ten cords of the best horse manure, plowed under in November, and 100 bushels of ashes as a top dressing. He also raised on another piece five bushels to the square rod. Manured with ten cords of barn-yard manure, and a mixture of equal parts of charcoal dust and ashes, using one bushel to a square rod. He considers 400 to 480 bushels as a fair average per acre.

J. W. Proctor, of Massachusetts, says that he can raise 400 to 500 bushels of onions from an acre by manuring with seven cords of compost

made of leached ashes, cattle manure, muck, and twenty bushels of bone dust, plowed under in the spring.

Bennett J. Munro, of Bristol, Rhode Island, says that the number of bushels raised in that town in 1849 was 69,892; in 1859, 84,094; in 1864, 71,734; and in 1863, 100,500, which is probably the largest crop ever raised in the State in one year. There were raised this year (1869) 80,000 bushels. The usual yearly average is somewhat less than 400 bushels per acre.

In Monterey, California, the average of the best crops of the large red onion, as given by C. A. Canfield, is about 300 bushels per acre. As a general rule no manures are employed in that part of the country.

Value of crops.—Seth Thayer, of Bristol, Rhode Island, reports the cost and value of his crop of four acres as follows:

2,610 bushels onions, at $1 50 per bushel		$3,915 00
1,200 bushels carrots, at 30 cents per bushel		360 00
		$4,275 00
Manure	320 00	
Plowing	20 00	
Fitting land	20 00	
Onion seed, 28 pounds, at $5 per pound	140 00	
Planting	6 00	
Carrot seed, 8 pounds, at $1 per pound	8 00	
Planting	8 00	
Hoeing five times	200 00	
Harvesting	144 00	
Interest on value of land, ($200 per acre)	48 00	
		914 00
Profit on four acres		3,361 00

Edward Atherton, of Rhode Island, sold in the field from one acre 600 bushels of Red Globe Wethersfield onions, at $1 per bushel, and 400 bushels of carrots, at 30 cents per bushel. Total, $720.

Manures.—Bennett J. Munro, of Rhode Island, after an experience of forty-five years in cultivating the onion, regards night soil as the best manure in use, and a compost of sea-weed, cow and hog manure next. Sea-weed alone spread on the land and plowed in makes a good manure. Wood ashes are an excellent and very durable top-dressing. He says the largest crop of onions he ever raised was grown on land manured with a compost of night soil and coal ashes, spread on the surface in the spring and plowed in. Composts of sea-weed and other manures should be made in the yard, where they may be worked over and trampled upon by the animals.

Samuel W. Church, of Rhode Island, considers horse manure the first in value, and a compost of sea-weed and hog manure formed in the pen the second. He applies ten or twelve cords to the acre, spreading it on the land in the spring and plowing it in. He sometimes uses guano, ashes, phosphates, or ground bone, in very small quantities, spreading them on the surface after the land is plowed, and harrowing them in.

J. A. Birchard, of Iowa, prefers hog or sheep manure for the principal dressing, spread and plowed under in the fall. He also applies ashes as a top-dressing after the onions are sown.

J. W. Proctor, of Massachusetts, says that no manure is better than that from the barn-yard where cattle are generously fed, and the shovel is faithfully used in fining it. Six to ten cords to the acre must be applied annually. He has rarely known a crop of onions to be injured by too much manure.

The fungus or smut.—Bennett J. Munro, of Rhode Island, says that, before the introduction of coal for fuel, wood ashes were generally used for top-dressing, and that the smut which has prevailed there to some

extent for some years was then unknown, and its present prevalence is attributed by many to the absence of wood ashes from the soil.

Samuel W. Church, of Rhode Island, says that the fungus or smut has prevailed in his vicinity for thirty years, with no remedy except taking up new land.

AMERICAN SUMAC.

The sumac is a small tree or shrub of the natural order of *Anacardiaceæ*, and is represented by the single genus *Rhus*, a name applied on account of the reddish color of the berries. The species in the United States, which possess an economic value, are *R. typhina*, or stag-horn sumac, which attains the size of a tree twenty feet high; *R. glabra*, or smooth sumac, a spreading leafy bush from four to ten feet high; *R. copallina*, a dwarf species from one to seven feet high, with fruit agreeably acid; *R. pumila*, a dwarf species of the pine barrens from North Carolina to Georgia; *R. aromatica*, or fragrant sumac, a dwarf, straggling bush, found from Vermont westward and southward; *R. metopium*, a tree from fifteen to twenty feet high, found in Southern Florida; *R. cotinoides*, a species allied to, or which, as Gray thinks, may be the same as the *R. cotinus*, (exotic,) or Venetian sumac or smoke plant, and which occurs in the interior of Alabama.

The uses to which sumac is applied may be stated briefly as follows: Its most important are in the application of its astringent leaves, ground to a fine powder, to tanning purposes in the manufacture of fancy morocco and other light leathers from the skins of sheep, goats, &c., and as a coloring matter in calico printing. In its latter application it affords, with a mordant of tin, a yellow color; with acetate of iron, weak or strong, a gray or black; and with sulphate of zinc, a brownish yellow. The bark of the *R. glabra*, or smooth sumac, is used as a mordant for red colors. Some species of the sumac have also a medicinal value. Those richest in tannic acid, and therefore most valuable for tanning purposes, are such as have small, dark leaves. The *R. glabra* and the *R. typhina* are most used for tanning in this country, and the *R. coriaria* in Europe.

Until within five years, almost the entire amount of sumac used in this country was imported from Europe, and still the larger proportion in use is of foreign growth and manufacture. It has been supposed that the American species were deficient in tannic acid, this opinion being the result of the want of care and skill in gathering the leaves, and their preparation at the manufactories. More care having been used in gathering and preparing sumac since 1867, it is now demonstrated, and acknowledged by consumers in our own country, and dealers in Europe, that American sumac, from the best mills, excels in quality and equals in preparation any in the world. An importing house, having branches in New York, Philadelphia, and Savannah, in a circular to the trade, issued December 31, 1869, says:

We would call the attention of the trade to a very fine Virginia sumac now being received by us, equal in every respect to the finest Sicily. We recommend its use from the following comparison in the analyses:

FINEST SICILIAN. *Lead Seal, "Pojero" and Ne plus ultra.*		FINEST AMERICAN. *Virginia.*	
Tannin	23.65	Tannin	30.00
Sand	1.00	Sand	.50
Vegetable fiber	75.35	Vegetable fiber	69 50
	100.00		100.00

SUMAC MILL.

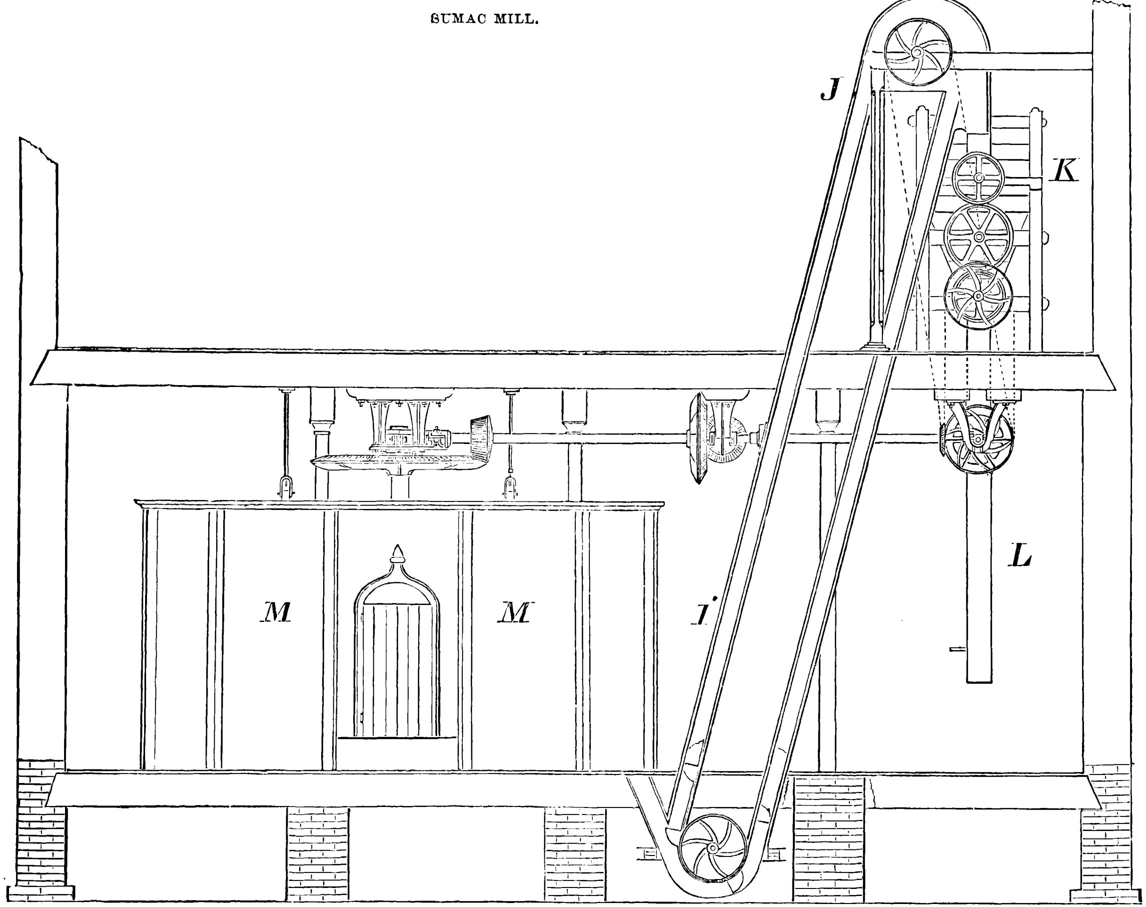


PLATE XXI.

A statement of analyses of American sumac, made in the laboratory of the Department, will be found in the report of the Chemist, page 65.

Alexander Macrae, a produce broker of Liverpool, England, who has personally examined the sumac manufactured in this country, in his Importers' and Exporters' Circular, of January 10, 1870, under the heading "Sumac," says:

A great revolution is about to be witnessed in this tanning and dyeing material. Supplies have commenced to arrive from Virginia, United States, the quality of which is the best that has ever reached Great Britain. The official analysis (Huson) shows that the finest brand of Sicilian, the "Ne plus ultra," gives 24½ per cent. of tannin, ½ per cent. sand; but the best samples of American (same analyst) yield 31 per cent. of tannin to ½ per cent. of sand. If, therefore, finest Sicily is worth 20*s.* per hundred weight, finest American is of the value of 24*s.* per hundred weight; but it is quite certain that as a rule the American will undersell the Sicilian considerably, although, as shown, the quality is 20 per cent. better. In common fairness it must be added, however, that the very *worst* tests of the American are superior to the *best* of the Sicilian; this includes not only the sumacs of Virginia, but those of Maryland, Tennessee, &c.

Notwithstanding the comparative excellence of American sumac, it has never sold in our own or foreign markets at so high a price as the Sicilian, bringing only a maximum price of $90 per ton, while the latter sells for $180. The low price of the home article probably induced consumers to try it, first in connection with the foreign, and then alone. The result of its use is so satisfactory that some of our print manufacturers declare they prefer it to the imported at an equal price; and one tanner of light leathers in Wilmington, Delaware, uses annually four to five hundred tons of sumac manufactured in Fredericksburg, Virginia. In one respect only is the home production inferior to the foreign; it has not yet been found capable, as generally manufactured, of tanning leather white, a quality which the Sicilian sumac possesses; but we are assured by a firm in Georgetown, District of Columbia, who are manufacturers of sumac, and also practical tanners, and who have given much careful attention to this comparatively new branch of industry, that even this difficulty has been solved by them satisfactorily; and that the defect is not in the natural quality of our species of sumac, but is of a nature that may be overcome in manufacture. Assuming this information to be reliable, there is no reason that American sumac should not supply at least the demands of our own markets.

The following table exhibits the amount of importations of sumac for the past six years:

Year ended—	Imports.	
	Pounds.	Dollars.
June 30, 1864	8,031,648	212,370
June 30, 1865	7,118,370	188,733
June 30, 1866	13,687,572	355,198
June 30, 1867	13,790,990	559,421
June 30, 1868	11,842,431	468,362
June 30, 1869	....	....

The entire consumption of sumac in the United States in 1869 aggregates over 10,000 tons of 2,240 pounds, and the domestic production was about 5,000 tons, of which 3,500 tons were prepared in Virginia. The increasing consumption is indicated in the preceding table, and in the fact of an increased supply of the domestic article, only a small amount having been exported. The value of the sumac imported, compared with other articles, may be seen in the fact that, in a list of 281 articles of drugs and chemicals imported in 1869 at the port of New

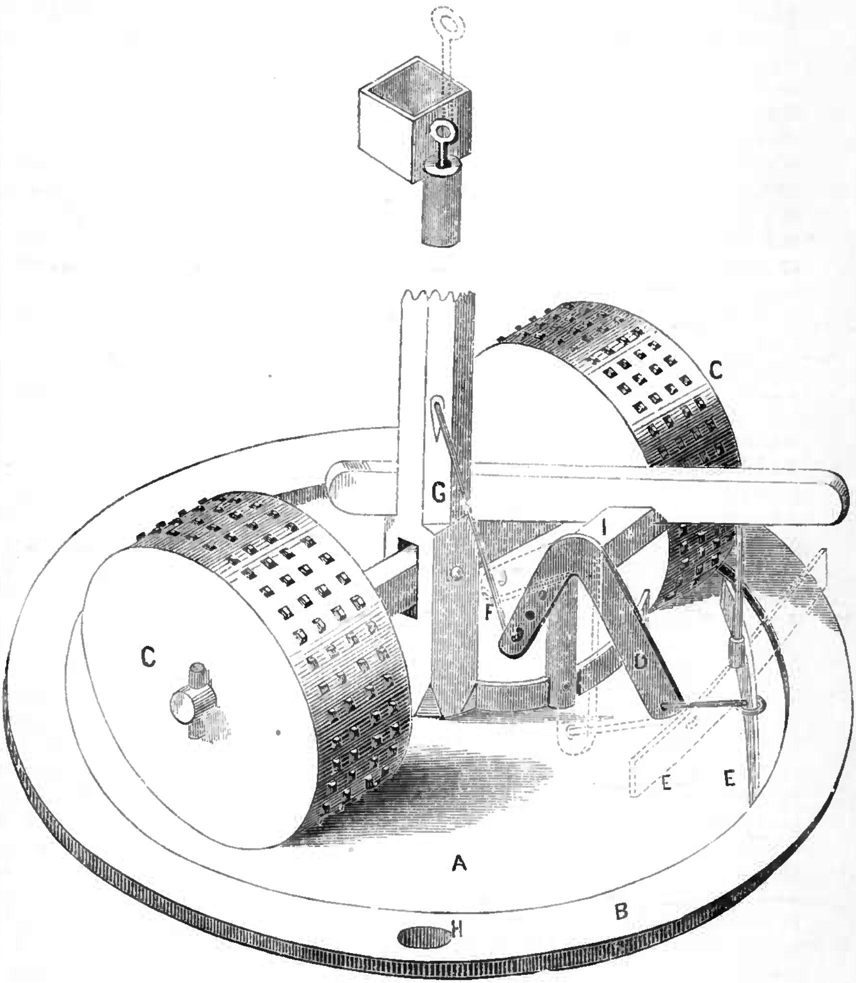
York, sumac stands fifteenth in aggregate value, being exceeded only by the various acids, Peruvian bark, bleaching powders, brimstone, cochineal, cream of tartar, garancine, indigo, madder, olive oil, opium, the various paints, soda ash, and nitrate of soda.

Where the sumac shrub is cultivated, as in Sicily, it is cut off entire, a little above the ground, after one year's growth, and the leaves threshed off when sufficiently dry. Shoots put forth from the roots about the stump, furnishing leaves for a succeeding harvest. The shrub is propagated by planting sections of the root, usually in rows far enough apart to allow of cultivation with the plow or hoe. It may be grown from seed, which should be soaked well before planting, in order to induce a more rapid germination; and whether roots or seeds are planted, it should be done previous to the rainy season of the year, to give the starting plants the benefit of sufficient moisture. In the United States, where the sumac has never been cultivated for use, its leaves are gathered by stripping or beating them from the shrub, at any time from the middle of July to the appearance of autumn frosts. The leaves are collected in the manner most convenient, and after being dried and separated from the branches and twigs, are delivered at the mills in the fall, the average price paid for them being $1 75 per 100 pounds.

A mill for grinding sumac leaves consists of a heavy, solid, circular bed of wood (marked A in the accompanying engraving) fifteen feet in diameter, with a depression around the edge (B) a few inches deep and a foot wide, for the reception of the ground sumac from the bed, and two chasers or rollers (CC) weighing about 2,500 pounds each, five or six feet in diameter, and provided with teeth of iron, or preferably of wood, thickly inserted. If the axle of a cart were set upon a pivot in its center, the wheels of the cart would describe a compound revolution similar to that of the chasers of a sumac mill. Most mills have to be stopped to allow the unloading of the bed, but a process, exhibited in the accompanying engraving, has been patented by Mr. Chase, of Alexandria, Virginia, which obviates this delay. The apparatus consists of an angular arm (D) attached to a scraper (EE) and worked by a lever, (F;) which passes through the hollow shaft (G) and extends to the room above, where it terminates in a handle, as seen in the section at the top of the engraving. The scraper carries the ground sumac to the opening (H) whence it is carried by the elevator, marked in the second engraving, (I,) such as is common in flour mills, to the revolving sieve or screen (K) in a room above. After screening, the sumac passes down through the tube (L) and is packed in bags, fifteen to the long ton, (2,240 pounds,) this article being always sold by that weight. The chasers and beds are inclosed in a huge case or drum, (MM,) and the grinding is done by the application of power to the upright shaft (G) between the chasers, and which moves them. The mills are fed from above. The packing is sometimes done by machinery alone. This description is of the best mills, which cost about $3,000. In Europe, and in some parts of the south, sumac is still ground by stones revolving on a stone bed, and the sifting is often done by hand.

The high estimation of our native sumac and its increased demand have convinced manufacturers that cultivation of the shrub will soon be necessary to give the needed supply. As the sumac possesses remarkable vitality, and flourishes upon the poorest soil, its cultivation may and probably will become a profitable branch of agricultural industry.

PLATE XXII.



SUMAC MILL.

CULTURE OF THE OPIUM POPPY IN SMYRNA.

The best ground for the culture of the poppy, (*Papaver somniferum*,) according to information received from E. J. Smithers, United States consul at Smyrna, is a light soil on a hillside having a rocky subsoil. This produces the light-colored opium, which is most esteemed. A low sandy soil of a dark color will produce a dark quality of opium, which is inferior to the former. To produce opium of the finest quality it is essential that the ground should be rich and dry.

After the first rains in September the ground is plowed several times at intervals, and well manured. Sowing usually commences in October. The seeds are mixed with two parts of earth, and sown broadcast. Many farmers consider it advantageous to draw a rake over the surface after sowing, in order to cover the seeds. Sowing at this season produces a better crop than at a later period, as the plant becomes stronger, and is not so likely to be injured by the cold. It has, moreover, this advantage, that, should the crop be destroyed, seeds can be sown again during the month of December or January.

As soon as the plants attain a growth of two inches they are thinned out, and a space of several inches left between them. The ground is then hoed, in order to lighten the soil as much as possible, and give air to the roots. This process is sometimes repeated while the plant is yet young.

The business of collecting the opium commences after the flowering of the poppy, which usually takes place about the 1st of May. Should rainy weather prevail, however, the capsules will not easily ripen, and the collecting must be deferred till the following month. The harvest continues through June, July, and to the middle of August. The change of the color of the capsule from green to gray indicates that it is ripe for the process required. This generally occurs from five to ten days after the withering of the flower, according to the state of the atmosphere. A small incision is then made on the side of the capsule as a test, and from this a milky substance is shortly seen to exude. If this falls to the ground the plant is allowed more time to mature; but if it trickles slowly down the side and adheres, there is evidence of full maturity. The operation for obtaining the opium now really begins. Curved incisions are made with a peculiar knife all around the capsule through the epidermis, or outer skin, and after a few hours the opium which has exuded on the surface is collected. One company of men are employed in making incisions upon such plants as they judge to be in a fit condition for the operation, and these workmen are followed, a few hours later, by others who collect the soft juice by scraping it off, and placing it on a tin plate held in the hand. When a sufficient quantity has been collected, it is transferred to a large leaf, in which it is enveloped. This leaf belongs to a plant closely resembling our domestic lettuce, and grows wild throughout the interior. Only the first quality is treated in this way. The inferior article is removed from the plate into a shallow wooden tub, in which it is left a few days to dry, and then rolled into balls of various sizes, and enveloped in leaves in the same manner as that of the first quality. These balls, varying in weight from one to three pounds, are placed in high narrow baskets, each being lined with fine linen made into a bag. Between the layers, and even between the balls, a quantity of an extremely fine husk of a certain grass, which everywhere abounds, is strewed to prevent the whole from becoming one mass. Each layer is firmly pressed down, and when the bag lining the

basket is full, it is strongly tied, and sealed with the seal of the owner. In this state it is brought on mules or camels to the Smyrna market for sale.

The purchase is concluded previous to any examination of the article, the understanding always being that it must be of the first quality. The baskets are conveyed to the warehouse of the purchaser, and opened only by the public examiners, who examine each piece, cutting open any that appear doubtful, and setting the second quality aside to be returned to the seller. These examiners, by long practice, become very expert in their business, and can tell at a glance, not only the quality, but even the district in which a certain parcel has been collected. They are now three in number, all Jews of the same family, who completely monopolize the business, as their forefathers have done for many generations. A commission of half of one per cent. on the value of the packages is paid to the examiners by the purchaser, the seller also giving them a piece of opium from each basket. After the examination has been completed, the opium is tightly packed in cases lined with tin, and ready for exportation, the tin lid being properly soldered down to prevent penetration of any dampness. The examiners fully guarantee the quality of the article which has passed through their hands.

The work of collecting the opium is performed both by men and women, the former receiving, in ordinary years, about sixteen cents, and the latter about ten cents per day. Last year wages rose very high in consequence of the great prevalence of fever, which laid prostrate many of the laborers, and quite a number died. The average cost of producing a chequi of opium of one and two-thirds pound, not including cost of plowing or land rent, may be estimated at forty piasters, or about $1 60.

The greater portion of this drug is produced in the district of Hara-hissar, situated upward of three hundred miles from Smyrna. The quality is good, and in a favorable season the yield may amount to 2,000 baskets of 175 pounds each, or half of all the product of Asia Minor. The other districts are Ushak, Inegiol, Bogaditch, Kirkagatch, Madem, Konieh, Sparta, Alacheir, Philadelphia, Yalavatch, Karagatch, Davsauli, Kutayiah, and Coula, which together produce about 2,000 baskets. The best quality is produced in Madem, and the next best in Bogaditch. The yield of the first is small, and amounts to only 20 baskets; Bogaditch produces 400 to 450; Konieh and Sparta, 500 to 600; Ushak, 200 to 250; the remaining districts, from 50 to 100 baskets each. The poorer qualities are the Alacheir, Yalavatch, and Karagatch, with which a good quality of the husk already mentioned is commonly worked up.

In conclusion, it may be remarked that the poppy is an exceedingly tender plant, the growth of which is attended with many dangers before arriving at maturity. A slight frost, continued rains, or great heat may ruin the crop of a whole district in a very short time. To be brief, the requisites for the proper development of the poppy are these: A rich, dry soil, proper culture, slight rains during the early part of its growth, and moderate heat at the time of flowering, to bring the capsules to maturity.

TEA CULTURE IN THE UNITED STATES.

It is well known, by experiments made upon a small scale in South Carolina, in Tennessee, and in California, that the climate of many parts of the United States is well adapted to the cultivation of the Chinese tea plant, (*Thea viridis.*) In China it is grown in the tract of country comprised between the twentieth and the fortieth degree of north latitude. It does not require a very warm climate, it is very hardy, and is said to do better when subject to some freezing in the winter than where it is not so exposed. The soil should be light and well drained. It is frequently found growing in its native country on hills in its wild state, but it flourishes on the plains, where the soil is well drained, and not too rich. Two crops of leaves are usually gathered in a year, one in the spring and the other in the fall. The spring gathering is considered the best. Sometimes three crops are gathered. The plants are set in hills four feet apart each way, and allowed to grow about three feet high. A plantation can be cultivated ten or twelve years before the plants need to be replaced by new ones. It takes two or three years for the young plants to arrive at sufficient size to produce a crop worth gathering. After a plantation is started, little labor is required to keep it in a flourishing condition.

Tea was introduced into the island of Java by the Dutch, and is now cultivated with good success. It is also cultivated in Brazil.

Enormous quantities of tea are consumed in different portions of the world. Great Britain is the largest consumer, using annually about 60,000,000 pounds. It was first introduced into England about 1661, and was worth from $30 to $50 per pound. In 1862 there were imported 109,000,000 pounds. It is used largely by the Dutch and the Russians. The imports into the United States during the ten years ending June, 1868, were as follows:

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1859	29,268,757	$7,388,741	1864	37,229,176	$10,549,880
1860	31,696,657	8,915,327	1865	18,595,314	4,702,856
1861	26,419,956	7,056,199	1866	42,978,576	11,116,623
1862	24,795,983	6,560,307	1867	39,892,656	12,415,037
1863	29,761,037	8,013,773	1868	37,843,612	11,111,560

The difference between green tea and black depends principally upon the manner of curing and the age of the leaves. The leaves of green tea are dried quickly, without being exposed to moisture after gathering. The black tea is allowed to lie out of doors during the night in the dew. Green tea is also sometimes colored with various substances, as indigo, to give it a fine green color. Dr. Junius Smith, of Greenville, South Carolina, has cultivated tea in the mountainous portions of that State. It was exposed to the frosts of winter, where snow fell eight or nine inches deep, without injury. There is no impediment to the cultivation of tea in the United States, so far as depends upon adaptation of soil and climate. According to the Report on Commerce and Navigation for 1868, the average price of tea per pound on which duty is paid is about 30 cents, to which a duty of 25 cents per pound must be added, and the charges for ocean transportation and profits of the importer. The producer in this country could not expect to get more than 60 to 75 cents per pound, and with the high price of labor here, it would seem scarcely possible at present to compete with the low price of labor in China,

where $3 to $5 per month are the usual wages. The Chinese are now flocking into our country on the Pacific coast, and a fair opportunity will be presented to them to prosecute this business, and ascertain whether it can be made remunerative. The culture should commence with them, as they are familiar with all the operations of planting and cultivating the shrubs and curing the tea, which will enable them to overcome obstacles that would require years for our people to understand and remedy.

Every profitable industry which can be introduced into our country is so much added to the national wealth, and should receive all the encouragement which the government can extend to it. If the experiments in tea culture now in progress in California with Chinese and Japan labor prove successful and remunerative, there will hardly be a limit to the extent which the culture may assume on the Pacific coast, and the production may be equal to the wants of the whole nation.

A California writer, in speaking of the introduction of tea plants into that State, says that—

> The location best adapted to their growth is found to be high, rolling land, cold enough to have some winter frost. Our foot-hills are exactly suited to them. They are very hardy, and a sufficient number has been planted to give satisfactory evidence that they will thrive, and it is believed that their culture will eventually prove as successful here as on the foot-hills of the snowy Himalayas of Northwestern India, where the plant has completely superseded all importations from China.

Herr Schnell, the manager of an experimental farm in El Dorado, where the Japanese colonists are engaging in the culture of tea and other crops cultivated in their own country, states that all the new plants at his grounds are raised from seeds, which are planted in rows in a manner similar to that in which beans are planted. The proper time for planting in that State is November or December. The sprouts begin to appear in about thirty days, and by the following May the plants will attain a height of fourteen inches. The tender leaves are then stripped off and placed under immediate manipulation. They are first put into a large copper pan and roasted; then placed in baskets and shaken and swung in the wind until they are freed from the moisture which has been exuded by the heat; then roasted again and rolled in the palms of the hands to separate the leaves and prevent them from crumbling into powder; then dried again in the baskets, by shaking and swinging; and lastly they are put into jars, when they are ready for market. After the shrubs have attained a proper size they are trimmed back to about three feet in height, and this process is practiced yearly. After having reached this size they will continue to yield good crops for over thirty years. It is desirable that the plants should have the morning sun. For this reason a location should be selected on the south side of a hill, otherwise the leaves will turn yellow and the tea be of inferior quality. Mr. Schnell has about 120 acres of good agricultural land ready for planting, and about 400 acres of rough land, which he proposes to clear as soon as practicable. He thinks that as good tea can be produced in California as in China or Japan, and that the only question as to the success of tea culture in that State is whether labor can be obtained at sufficiently low rates to render the business profitable.

A correspondent in Mississippi writes that he received from the Department of Agriculture a number of Chinese tea plants in the spring of 1859, and that they are now four to six feet in height, and three to four feet across the heads. They begin to bloom in September and continue until checked by the severe frosts of December. He dried the leaves in the shade, in the sun, and by the fire, but failed to secure the delicate taste and fragrance of imported tea. The effect, however, of the tea on the system was, to some extent, the same as that of the imported article.

A writer in North Carolina states that tea has been growing in that State for thirty years, and the knowledge of the Chinaman in growing and curing it is the only thing wanting for its successful culture. He says:

The plants are very hardy and prolific, and after being once planted will propagate themselves spontaneously. They flourish in sunshine and shade, in marl, clay, and rocky soil without cultivation. Five crops of leaves are usually picked in a year. The first picking makes the green tea, and the later, the black tea.

THE CULTURE AND PREPARATION OF TEA.

A communication has been received from H. A. Shipp, lately a tea-planter at Cachar, India, embodying a brief statement of the Indian mode of culture and preparation of tea. He refers to the green and the black teas of commerce as obtained from the same plant, differing only in age and manipulation, classifying among the former, Twankay, Hyson, Hyson-skin, Imperial, and Gunpowder; and among the latter, Souchong, Oolong, Congo, and Bohea, and remarks upon the importance of certain requirements in the cultivation and manufacture of tea, without which success can never be obtained; as the suitability of the site selected for the plantation; the facilities for transportation; the kind of labor; the experience, theoretical and practical, of the manager; and the sufficiency of capital. He claims that there is a large extent of land in this country well adapted to the production of tea, lying between the parallels of 29° and 35° north latitude, and which embraces North and South Carolina, Georgia, Alabama, Mississippi, and also in portions of California, all lying within the summer-rain boundary line, and possessed of rivers which would answer for purposes of irrigation, should a season of drought occur.

SITE, SOIL, AND CLIMATE.

Mr. Shipp recommends as the best site for a tea plantation, one adjacent to water or other means of transportation, flat or slightly undulating, sufficiently elevated to give a natural drainage to the soil. Steep localities, which are liable to land-slips and difficult of cultivation, should be avoided. Proximity to water is advantageous for easy irrigation of the nurseries, as well as of the young plants during their first year's growth, and for the ready transport of the manufactured tea. The soil preferable is a light, friable, ferruginous clay, free from stones or slate, which prevent the tap-root from penetrating to a sufficient depth to allow the plants to attain their full vigor.

The climate where the tea plant has been found to thrive best is that in which periodical rains fall, and where the heat is not so intense as to check the full development of the plant, or a temperature ranging from a maximum of 100 to a minimum of 30 degrees, though tea will grow in much colder latitudes, and is not killed by a light frost. Tea grows in China even at an altitude of 9,000 feet above the level of the sea.

PLANTATION.

The preparation for the plantation should be governed by the kind of seed used, and the manner in which it is to be sown. It may be sown either at the stake or in nurseries for transplanting. If the former mode be pursued, the whole of the land should be cleared, with the exception of such trees as may be deemed necessary for building or other important purposes, unless so numerous as to cause excessive shade.

Under any circumstances, it is judicious to retain or plant light shade-trees on the western side to protect the young plants from the fierce afternoon sun. Indigenous seed should always be sown in nurseries, as it produces plants which are very tender and very susceptible to sudden changes of temperature; they should never be removed to plant out until the second year. The system of planting or transplanting from nurseries has been much approved for all kinds of seed, as the expense of one season's cultivation is avoided by retaining the plants in the nurseries till they are one year old. It is necessary to tend the nurseries carefully, and make the seedlings as thrifty and vigorous as possible that they may bear transplanting.

LAYING OUT A PLANTATION.

In laying out a plantation, the first thing to be done after plowing is to line and stake off roads, twelve to fifteen feet for the breadth of the main roads, and six to nine for the cross-roads; after which, lines for plants should be marked off at right angles to the roads, as much for economy of labor in planting out as for the subsequent appearance of the plantation. These lines should be crossed transversely at a distance of six feet, and at each intersection a good stake, three feet high, should be driven firmly into the ground to mark where the seed or plants are to be placed.

Fruit and ornamental trees may be afterward planted along the sides of the roads in such a way as not to interfere with the growth or cultivation of the tea plant, while the effect on the plantation will be enhanced.

FACTORY BUILDINGS.

The residence of the manager and the principal factory buildings, as storehouse, tea factory, packing and drying house, &c., should be in a central and elevated position to insure easier supervision of the estate, and equalization of distances.

Wells, "latrines," and manure pits should be built from pecuniary and economic considerations. On a plantation of one thousand acres are the manager's residence; tea factory, 200 feet by 60 feet; drying and packing house, 60 feet by 30 feet; storehouse, 100 feet by 50 feet; stables, out-houses, and houses for the occupancy of permanent laborers. All of these buildings may be of wood, except the storehouse and factory, which should be of masonry or corrugated iron.

PREPARATION OF SOIL, AND SOWING OF SEED.

Immediately after plowing, the land should be harrowed until the earth is well pulverized, that transplanting may be done with greater facility and more security. After the soil has been prepared as described, a hole one foot deep and nine inches wide should be dug at each stake for the reception of each plant.

The seed, immediately on the arrival at the factory, should be placed in damp beds from six to ten inches deep, carefully prepared for its reception, a layer being deposited broadcast as close as the seeds will lie, and sprinkled with soil to the depth of one inch, succeeded alternately by a layer of seed and one of soil, until the pit is filled up. It should then be covered with mats or straw, and watered. The mats or straw are placed over the pit to prevent the action of the sun's rays

affecting the seed. Seeds which sink when thrown into water will produce the sturdiest plants.

FORMING NURSERIES.

The season for forming nurseries in India is the month of November, and they should be made on land as level as possible, in the form of beds six feet wide, and as long as convenient for those tending and watering them. The site should be near water.

The mode of forming nurseries is as follows: Mark off the beds, leaving a space between for a passage-way; turn up and pulverize the soil to the depth of eighteen inches; turf the sides of the beds to prevent them from washing away, and make the surface smooth and level, but raised above the passage-ways ten or twelve inches. After the beds are ready sow the seeds one inch deep, and three or four inches apart, in straight rows; then cover them with a layer of straw, and water daily until the plants appear above ground; afterward watering is necessary only when the soil becomes dry. Weeds should not be permitted to grow. If the climate is cold or frosty, the depth of straw may be increased, and the watering dispensed with. In fact, a man must use his own common sense in such details.

Should grubs, caterpillars, ants, or other insects attack the seedlings they may be speedily exterminated by turning a few domestic fowls into the nursery, as, from close observation, it has been proved that the fowls do no injury to the plants.

Goats, sheep, squirrels, rats, rabbits, monkeys, hedgehogs, and deer injure the tea plants; and where any of these animals exist in large numbers it is necessary to guard the nursery.

TRANSPLANTING.

Transplanting should be attempted only on a dull, cloudy, or wet day, and not until the rainy season has set in, except where there is every facility for irrigation.

In removing seedlings from the nursery too much care cannot be taken, as the life and health of the plant depend entirely on the manner in which this is done. The best mode is to dig a trench at the end of the bed to twice the depth of the tap-root, and then remove each row separately in succession, with a spade, laying them in flat, circular baskets, roots to the center, covering the latter with earth to protect them from exposure.

MODE OF PLANTING SEEDLINGS.

On arrival at the place where they are to be planted, a hole sufficiently large should be made with a dibble in the hole already described, to admit of the tap-root going straight down to a proper depth so that the lateral rootlets shall not be too near the surface. In transplanting the plant should be suspended in the hole by one hand and the earth crumbled and pressed firmly around the roots with the other, until the seedling is firmly set. The object of digging the first hole to a depth of one foot is to prevent the lateral roots from being too near the surface when the plants arrive at maturity, which would render them liable to be cut with the hoe or plow; whereas, by adopting the plan here recommended the hole will, in the course of the first year, gradually fill up. The ground should be constantly turned over by hoe or plow to prevent the growth of weeds. Manure should also be applied frequently.

PRUNING.

This is a matter on which much discussion has arisen and much diversity of opinion prevails, as on the successful results of it mainly depend the luxuriance of yield of the tea crop, and the ultimate welfare and duration of the plantation. In the first year it is sufficient to top the plant, which is done by nipping off the upper green stem with the forefinger and thumb, as this arrests its upward and promotes its lateral growth. In the second year the plant ought to be cut down to twenty-one inches, and all the smaller branches stripped off to eight inches above the ground, by breaking, not cutting them, which will prevent them from again shooting forth. Much depends on the care with which this is done, as, if neglected or carelessly performed, the danger of affecting the plant in the succeeding year will be increased, while a free circulation of air at this critical time greatly benefits the tea tree, and the removal of all branches to a height of eight inches from the ground lessens the liability to attack and destruction by insects, results likely to follow if the branches are allowed to trail on the ground, and dirt and rubbish permitted to accumulate round the stem of the plant.

In the third year the pruning should be performed by trimming with the knife in preference to the shears—which, unless used by those who understand them, only break and jag the plant—so as to give the branches an upward tendency. All straggling branches should be closely trimmed round the sides, and a conical form given to the plant.

The fourth year the branches should be neatly trimmed round the sides of the plant, and cut down to twenty-four inches, in a flat, table-like shape, the secondary laterals being thinned out from the center, if the plant is not sufficiently ventilated, as too dense a growth in that part is highly injurious, care being taken at the same time to remove all the cuttings from the plant.

In the fifth year much the same system may be pursued, with the exception of the pruning being made more concave toward the center, allowing three inches below the margin of the bush.

In the sixth and all succeeding years the planter must be guided by the requirements of the tea tree, exercising his own discretion, bearing in mind that by cutting away all old wood he promotes the growth and development of new shoots, which are essentially required for manufacturing purposes.

MANUFACTURE OF TEA.

The plucking season commences about the end of April, and continues till the end of October, during which time a series of "flushes" occur at intervals of twelve or fifteen days, according to the weather, and thus twelve crops of leaves may be gathered in one season.

The plant should not be plucked before the third year, and then only very lightly, as overplucking will render it weak and sickly. The yield of a highly cultivated tea plantation is about one pound of tea to the tree, or four pounds of leaves in their green state. Thus an acre of land planted six feet by six contains 1,210 plants, and consequently yields that number of pounds of tea when in full bearing.

PLUCKING THE LEAVES.

The most advantageous method of plucking is to divide the laborers into three gangs, in number according to the "flush" to be gathered, each gang having an overseer. The Pekoe gang should be composed

of women and children, as they are in every way better fitted for such work. They nip off the buds or convoluted leaves from which Pekoe is made. This gang should be followed by the Souchong gang, who gather the next two or three leaves on each stem, and they be succeeded by the Congo pluckers.

The object of dividing the pluckers is to keep the leaves separate for the manufacture of each class of tea, when brought into the factory for manipulation. Another advantage gained by this careful classification is, that it prevents the coarser and harder leaves from breaking the leaves of the finer teas during the process of rolling, and, furthermore, obviates the necessity of so much sifting as would be required if all the teas were manufactured together. There is considerable art in plucking the leaves, so as to induce a growth of young leaves.

On delivery of the leaves at the factory they are first weighed, and then strewn thinly on the shelves which line the walls, for the purpose of cooling, when twenty or thirty pounds should be issued to each roller, who places them out in the sun or artificial heat to wither, beating and tossing them with his hands, and picking out all coarse and unrollable leaves. After the leaves are sufficiently withered (which can be ascertained by compressing a handful; if, on opening the hand, the leaves have lost their elasticity they may be considered withered) they must be taken back into the factory, cooled and rolled on tables in small portions, and made into balls until all the leaves have been rolled.

Then the first rolled are again rolled, and all obstinate leaves picked out, to be afterward rolled with the coarser teas. The leaves being now ready for the pans they are transferred to them, and the roasting process commences, the pans being kept to a uniform heat of 180° F. After being roasted for ten minutes, during which time the leaves must be kept stirred and tossed about to equalize the roasting and to prevent burning, they must be again rolled until the required twist or turn is given to the leaves, when they are again roasted at 212° F., and finally rerolled and placed in a heap for two or three hours, when the drying process commences. This is effected by spreading thinly on circular trays, or sieves, placed over charcoal fires until dry, which occupies six to seven hours, according to the weather. When thoroughly dry the tea is taken to the packing-house and there classified by being passed through sieves of different sizes, after which it is stored in large bins lined with lead or zinc—to collect the teas of one flavor *en masse* before packing.

Flowery Pekoe is manufactured in a manner different from that applied to other teas, and is briefly as follows, viz: The young shoots, as soon as brought into the factory, are allowed to cool and the leaves to dry, after which they are exposed to the sun until perfectly limp, when they are again cooled and tossed about. They are then again put under the influence of the sun for about twenty minutes, and finally dried over charcoal fires and kept covered closely to confine the aroma. This tea should be packed hot, whereby the flavor is enhanced.

GREEN TEA.

Very little green tea is manufactured outside of China, the laws of other tea-growing countries not permitting the coloring of teas. The following is a brief sketch of the Chinese method, viz: The young leaves, as soon as gathered, are taken to the factory and spread out to cool and dry, which occupies considerable time. They are then put into hori-

zontal pans and submitted to a heat of 150° F. until perfectly soft and pliable, being kept constantly stirred to prevent the leaves from sticking and burning. They are then made up into balls and exposed to the sun or heated air, the balls being frequently pressed by hand to express the juce. This operation takes about sixteen hours, and is the process by which the coloring matter (tannin) is extracted, and the flavor produced. The tea is then roasted in the horizontal pans until perfectly crisp and dry, after which the coloring takes place. The coloring matter is gypsum, turmeric, and Prussian blue, or indigo.

The present mode of manufacturing tea is no doubt very primitive, and one that is capable of vast and important improvements, especially in the rolling process. Machinery has been invented and has been found to answer pretty well. There is no better country than America to overcome the difficulty of hand labor by machinery, and, therefore, the want of cheap labor may not be an insurmountable obstacle to tea manufacture in the United States.

TESTS OF DEPARTMENT SEEDS.

The Department distributed, in the year 1869, 317,347 packages of seeds and plants, including, in addition to valuable varieties of the cereals, 125 kinds of vegetable seeds, 45 varieties in families of the choicest imported flower seeds, and many descriptions of grass and field seeds, cotton, tobacco, rice, &c. With a view to exchanges in kind, a large variety of seeds and plants has been sent to foreign societies and to individuals abroad. To the Botanical Garden at Melbourne, Australia, 103 varieties of American tree seeds and plants were sent, and the same number respectively to the Imperial Royal Minister of Agriculture, Austria; the Royal Botanical Garden near London, England; and the Royal Botanical Garden at Madrid, Spain. Thirty-two packages of seeds and cereals were sent to the Cape of Good Hope Agricultural Society; 640 packages of vegetables, 134 of tobacco, and 86 quarts of grain to Hon. J. J. Roberts, Monrovia, Africa; 50 pounds of American upland cotton seed to the Chinese government; 133 packages of vegetable seeds to the government of Japan, and 22 packages of vegetable seeds and cereals to the government of the Argentine Republic.

The demand for seeds has been so great from all sections of the country, and the supply so small, on account of the limited appropriation of Congress, that the Commissioner has been compelled to confine the distribution chiefly to members of Congress, to statistical correspondents, to meteorological observers acting for the Department, and to county and State agricultural societies, by which means they are judiciously disseminated.

The importance to farmers of procuring good seeds is annually becoming more obvious. Varieties of the cereals formerly prized have been year by year deteriorating, and the product per acre of staple grains has been steadily diminishing. Perhaps one of the principal causes of deterioration is the slight attention paid by farmers to the selection of seeds. It is not sufficient, however, to secure good seeds. The best seeds will deteriorate on worn-out or poorly-prepared soils; yet there seems to be no good reason why farms that at one time yielded thirty bushels of wheat per acre should now produce only twelve to fifteen bushels.

Tabular statement showing the quantity and kind of seeds issued from the seed division of the Department of Agriculture from January 1 to December 31, 1869, inclusive.

To whom sent.	Vegetable and garden seeds, 125 varieties.	Flower seeds, 45 varieties.	Field cereals.						Textiles.		Total.
			Winter wheat, 5 varieties.	Winter rye.	Spring wheat.	Oats, 3 varieties.	Barley, 2 varieties.	Corn, 9 varieties.	Ramie.	Cotton.	
	Pkgs.	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*
Members of Congress	56, 604	16, 564	2, 513	1, 622	4, 883	5, 991	1, 804	120	1, 996	100	92, 197
Agricultural societies	46, 738	4, 720	2, 072	252	1, 804	4, 940	3, 120	640	434	....	64, 720
Correspondents	58, 390	....	....	....	30	2, 627	1, 785	837	2, 442	....	66, 111
Meteorological observers	11, 440	....	....	....	....	1, 576	....	....	....	....	13, 016
Miscellaneous	22, 852	16, 068	2, 272	214	3, 978	3, 020	646	17	654	50	49, 771
Total	196, 024	37, 352	6, 857	2, 088	10, 695	18, 154	7, 355	1, 614	5, 526	150	285, 815

To whom sent.	Other seeds for field culture.										Tree and forest seeds, 103 varieties.	Total.
	Turnips, 19 varieties.	Tobacco, 5 varieties.	Sorghum, 2 varieties.	Clover, 2 varieties.	Bromus Schraderi.	Osage orange.	Opium poppy.	Rice, 3 varieties.	Olives, 24 varieties.	Potatoes, 12 varieties.		
	Pkgs.	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*	*Pkgs.*
Members of Congress	....	19, 443	37	820	54	....	....	88	94	344	....	20, 880
Agricultural societies	....	....	4	....	54	....	....	....	....	....	....	58
Miscellaneous	6, 478	1, 164	173	266	....	496	1, 206	47	47	305	412	10, 594
Total	6, 478	20, 607	214	1, 086	108	496	1, 206	135	141	649	412	31, 532

The greatly increased value of the wheat and oat crops, consequent upon the introduction of new varieties, may be satisfactorily demonstrated by facts.

As shown by the annual report of the Department for 1868, the wheat crop reached 224,036,600 bushels; acreage, 18,460,132; average yield per acre, 12.1; value of crop, $319,195,290; average price per bushel, $1 42. The reports of experiments with the Tappahannock wheat distributed by the Department show an average yield per acre of twenty-five bushels; the total yield at that rate, on the acreage of 1868, would be 461,503,300 bushels, an increase of 237,466,700 bushels; which, at $1 42 per bushel, would be a money value increase of $337,-202,714. If this wheat were to take the place of other varieties, however, and should be sown as the general crop is now sown, without the special care usual in experimenting, the average yield would of course fall below twenty-five bushels; but if the average increase per acre could be raised to fifteen bushels, (a low estimate for the Tappahannock, the increase in bushels would be 55,380,396; in money value, $78,640,162.

The oat crop of 1868 was 254,960,800 bushels; acreage, 9,665,736; average yield per acre, 26.3 bushels; value of crop, $142,484,910; average price per bushel, fifty-five cents. Reports of experiments with the Excelsior oats, a new variety, introduced by the Department, show an average production of forty bushels per acre, sixty bushels not being an uncommon yield. Estimating the average yield, if generally introduced, at 30.3 bushels, an increase of four bushels per acre over the average yield of 1868, and the addition to the wealth of the country in the item of oats would be 38,662,944 bushels, or $21,264,619.

The weight of the product of the Excelsior oats for a few years after their introduction may be fairly averaged at twenty per cent. above the common varieties, estimating the latter at thirty pounds to the bushel, and the former at thirty-six, although in many cases forty and forty-five pounds per measured bushel have been reported. Add twenty per cent. to the sum above ascertained and an increase will be shown of $25,517,542.

It is the object of the Department to distribute superior varieties only; but the adaptability of these varieties to the climates and soils of the country must be determined by actual experiment, and the Commissioner must rely upon the results attained by intelligent experimenters in order to furnish proper recommendations to farmers generally. To make these experiments satisfactory and valuable, more is necessary than simply to report success or failure in general terms. Such data should be given as may be of use in comparison, the date of sowing or planting, the time of maturing and harvesting, the quantity of seed sown, and the amount and quality produced; and, if wheat, oats, or barley, the weight of straw and grain respectively. The quality and treatment of the soil should be accurately stated. Such details would enable persons interested to form an accurate judgment as to the value of any specific variety, and especially as to the climate and soil in which it will prove most successful. Many reports received by the Department lacking such data are of no value whatever for reproduction.

Some of the results of trials made with leading cereals distributed by the Department are here presented. The great number of the varieties of vegetable and other seeds, concerning which reports have been made, renders it impracticable to embrace them all in this article, and it is perhaps sufficient to say that a large majority of the new and improved varieties of such seeds have given satisfaction where their merits have been fairly tested.

TAPPAHANNOCK WHEAT.

The Tappahannock wheat has been widely distributed by the Department since the spring of 1862, and the most favorable reports concerning its value as a new winter variety have been received. These reports, from many and widely separated portions of the country, agree in placing it among the most desirable varieties. It possesses the characteristics of a superior wheat, maturing early, yielding heavily, rarely sustaining damage from weevil or midge, rust or smut, giving a superior quality and yield of flour, and withstanding severe winters on account of its vigorous growth. Few correspondents, who have given this variety a fair test, decide against its merits as an excellent winter wheat. There is a great diversity in the reported yields, but this arises, of course, from the different methods of treatment, the soil, and the season. Numerous returns have been received of satisfactory experiments in the New England States, the details of some of which were published in the last annual report.

A correspondent in Alleghany County, New York, says of his crop, raised from seed furnished by the Department, that it equals the original seed, is pure and clean, has a short, stiff straw, will stand rich ground, and is ten to twelve days earlier than any other variety yet raised in that county.

From Tioga County, Pennsylvania, a correspondent writes that the Tappahannock is ten days earlier than any other variety grown there, and yields well. A similar account comes from Greene County. A result of replanting is reported from Somerset County, in the same State. One quart yielded ten; the ten quarts produced four bushels and one peck; and the four bushels yielded forty-six and a half bushels of excellent wheat.

There is a marked unanimity among experimenters in the Southern States in favor of the Tappahannock, as being well adapted to the climate and soil of that section. In Maryland it ripens early, thereby avoiding danger from the weevil, which in some seasons makes sad havoc with the more slowly maturing varieties. A Harford County farmer reports a yield of thirty-two bushels to the acre, weighing sixty-two and a half pounds per bushel. In several counties of Virginia where this wheat has been fairly tested, it is supplanting other varieties. The seed distributed in Shenandoah County ripened ten days in advance of any other variety, and yielded abundantly.

From Tazewell County the report is made that twelve pounds of Tappahannock "produced two hundred and fifty pounds of beautiful wheat; in fact, the finest grain ever seen in the county. The straw was of a bright golden color; the grain plump and very fair, ripening ten to twelve days earlier than any other kind." The seed was sown late and the crop sustained injuries from fowls, rabbits, &c.

In North Carolina, this variety has done well on highly improved and new land, but poorly on thin soil. By several correspondents it is pronounced superior to any other kind for fullness and freedom from disease. The increase, as shown by reports from eleven counties, varies from thirteen fold to forty-one fold. On common land the yield was eighteen fold; and sandy loam, with a top-dressing of stable manure, twenty-four fold; on upland clay soil, twenty-eight fold. One experimenter sowed Tappahannock in the same field with the Purple-straw, sowing at the same time; the former ripened four days earlier than the latter, yielding thirty-three fold, while the Purple-straw yielded ten fold. In South Carolina the Tappahannock is found to mature ten days earlier than

the Alabama wheat, and three weeks earlier than the Rough-chaff. Reports of its tillering well come from this State. In Abbeville County, there was a return of twenty-two and a half fold on red, stiff land, well prepared and manured. Union County reports an increase of thirty-two fold, weighing sixty-two and a half pounds to the bushel.

Several Georgia correspondents state that the Tappahannock wheat is the best yet introduced into their respective localities. In one instance, where sown on land manured with sheep droppings, the yield was forty-five fold. Clayton County reports the largest ratio of increase, sixty fold.

A Crawford County correspondent reports that the Tappahannock is an early variety, comparatively free from rust, very prolific and heavy, weighing four pounds more to the bushel than kinds usually sown.

Excellent yields are reported in Carroll County and in Hall County, the grain in each case weighing sixty-five pounds to the bushel. Nine counties report favorable experiments. On thin land in Warren County there was an increase of thirteen fold—about fifty per cent. more than the usual harvest on similar land.

Calhoun County and Clay County, Alabama, give encouraging accounts of the trials made with this variety, both as to early maturity and heavy ratio of increase. The Grayson County (Texas) correspondent reports that the Tappahannock did much better than any other variety with which experiments have been made in the county, yielding about forty bushels per acre, and weighing sixty-three pounds to the bushel. Correspondents in Arkansas report that the Tappahannock is much the best variety for the soil and climate of the western portion of the State. In Drew County, in the southeastern part of the State, on account of early sowing and manuring, the Tappahannock headed earlier than any other variety. A Montgomery County correspondent states, however, that it is a week to ten days later than common May wheat, and is consequently more liable to rust. A correspondent, writing from Coffee County, Tennessee, says that vigorous growth, hardiness, early maturity, and freedom from smut and rust, commend the Tappahannock as the most desirable variety of winter wheat. In Maury County, one-fourth of a bushel upon cotton land, sown the last of November, and cut in the second week of June, yielded three hundred and twenty-six pounds—about five and a half bushels, or twenty-two fold. A McNair County correspondent says that it matures finely, stands the winter well, and is earlier than other varieties. A peck of the Tappahannock sown in Polk County, in stiff, mulatto soil, without manure, yielded fourteen fold better than other varieties on the same soil. In Obion County it is reported as standing wet land better than any variety in that section, yielding at the rate of eleven and a half bushels per acre more than the average. A Braxton County (West Virginia) correspondent states that Tappahannock fully satisfies expectations in that section, and that it is the general opinion of farmers that it is the best wheat yet raised in the county, being hardy, early, of good quality, standard weight, and yielding well.

Favorable accounts have been received from Hopkins, Livingston, Russell, and Scott Counties, Kentucky, all uniting in the opinion that the Tappahannock ripens earlier, affords a larger grain, and is heavier than varieties usually sown in those counties, and that it is the best wheat for the climate. One peck sown on tobacco land in Edmonson County yielded five and one-fourth bushels—considered an extraordinary yield in that locality. A farmer of Garrard County states that he sowed sixty bushels of Tappahannock, at the rate of one bushel per acre, on

land consisting of limestone mold, with reddish clay sub-soil, mixed with gravel. The land had been cultivated in corn for fourteen years without change, except a crop of oats preceding the breaking of ground for wheat. Notwithstanding a drought, the yield was sixteen bushels of the very best wheat per acre. Its matted roots prevented freezing out, and its early ripening was a guarantee against rust.

The Tappahannock has succeeded well in Missouri. From a quart of seed sown in Howard County in 1866, as an experiment, and the product sown each fall, the yield in 1869 was one hundred bushels of plump wheat, "far superior to any other grown in the county, and yielding one-third more than other varieties, or thirty bushels to the acre, weighing sixty-six pounds per bushel." The Phelps County correspondent says:

On the 6th of October I sowed twenty pounds of Tappahannock wheat on corn ground, sandy loam, plowed six inches deep with turning plow, and well harrowed in, and rolled in the spring. It was harvested June 18, full three weeks earlier than other wheat in the same field, sown at the same time, and treated in the same manner. The return was four hundred and sixteen pounds of clean, plump wheat, or about six bushels and three quarters, weighing sixty-two pounds to the bushel—about twenty-one fold; while my other wheat in the same field yielded only eleven fold. I think it will prove to be the best wheat for this county.

In Stoddard County the lowest yield of Tappahannock was thirty-five bushels to the acre, pronounced superior to any ever grown in the county. A correspondent writing from Washington County says that the Tappahannock is admirably adapted to the soil and climate of Southeastern Missouri.

From the Western States the reports of experiments with the Tappahannock wheat are not so general nor full as was to be expected from the amount distributed. Correspondents in Fulton, Jackson, and Massac Counties, Illinois, report fair yields.

In Brown County, Indiana, the grain is large and plump, and is thought to be a good wheat for rich bottom land. In Jasper County it made a good yield, weighing sixty-two pounds to the bushel. From Spencer County it is reported to be admirably adapted to the climate of that section, a first-class wheat for rich bottom lands, and that of five varieties sown on one farm the Tappahannock was the earliest. It yielded well in Washington County, but not more than some other varieties, the smut in some cases injuring it seriously. Another Indiana correspondent writes:

I sowed four quarts of Tappahannock wheat on the 15th of October, 1868, on a heavy clay soil, from which a crop of sugar cane had been harvested. It was well stirred with the plow and manured, after which the wheat was sown and harrowed in. Harvested June 26, the yield by measurement being three bushels and one peck, weighing one hundred and ninety-five pounds. Heads, full; kernels, somewhat larger than the Genesee, and similar in general appearance.

In Henry County a farmer sowed, on the 5th of October, 1868, one peck of the Tappahannock broadcast, harrowed it in, and then rolled the ground. It was sown on about one-fourth of an acre, that had produced a crop of corn which was cut off and the ground broken up. Although sown late, this wheat was the first of several varieties to ripen; was cut July 3, and yielded nearly five bushels of superior wheat.

Where experiments have been made with the Tappahannock in Ohio satisfactory results have been attained. A quart received by a farmer in Ashland County late in 1866, produced twenty-five pounds; this product sown, yielded six and three-fourths bushels; and the latter, in turn, one hundred and forty-two bushels, weighing sixty-five pounds to the bushel. An Erie County farmer reports that from one quart, received three years ago, he has now one hundred and fifty-six bushels of "splendid wheat." Another farmer, in Champaign County, from one

quart, received three years ago, and cultivated each season, this year threshed one hundred and forty bushels as good in quality as the original seed. A Henry County correspondent says:

The Tappahannock wheat received two years ago from the Department has been grown two years in drills. The second season, one bushel drilled on one hundred and forty square rods yielded twenty-two and one-half bushels, or at the rate of twenty-five and six-sevenths bushels per acre, while the Michigan White variety, in the same field, yielded only eighteen bushels per acre; the Tappahannock ripening two weeks earlier, and giving much finer grain.

A Highland County farmer reports that he sowed a quart of Tappahannock, with the following results: Product first year, twenty-two pounds; second year, four and one-half bushels. From the four and one-half bushels the third year he has four acres, which he thinks will make one hundred and twenty bushels of very fine quality. It stands up well on rich ground, and ripens a week or ten days earlier than the Red-chaff Mediterranean, all the grains being perfect. In Hardin County the Tappahannock is found to be earlier and better than the usual varieties sown, and in Logan County it matures ten days earlier than ordinary varieties. In Meigs County a farmer sowed broadcast eight bushels of the Tappahannock on high second creek bottom land, the product being one hundred and eighty-six bushels; another sowed broadcast one and a half bushel on fallow ground, sandy hill land, formerly timbered with white oak and poplar, and harvested forty-eight bushels.

C. E. Goodrich, of Ionia County, Michigan, says, in the Western Rural of July 22, 1869, that five years ago, when his attention was first called to the subject, he became satisfied that the Tappahannock was the earliest white wheat, since which time he has been testing its various qualities with the view of its taking the place of the Soulé. He has found it to be the earliest, that it has so far invariably evaded the attacks of the midge, and that the weight averages sixty-four to sixty-six pounds per bushel, while the yield is fully equal to that of the Soulé. From fifty-five acres sown by himself and neighbors in the fall of 1867, there were harvested 1,562 bushels, or an average of over twenty-eight bushels per acre. This was sown on as great a diversity of soil and had as different treatment as any one could desire for experimental purposes. On a heavy timber land farm, which had not raised a good crop of wheat for five years, on account of the midge, it gave thirty bushels per acre. On another field of river bottoms it lodged so badly as to compel the use of the scythe and horse-rake in harvesting, but gave, notwithstanding the heavy loss in gathering, thirty-five bushels to the acre, the kernel of which was so plump and white as to pass readily for "extra white" in market. From three acres of corn ground he harvested one hundred and ten bushels. Mr. Goodrich is satisfied that whatever could be expected of the Soulé under the most favorable circumstances can be relied on from the Tappahannock, and very pertinently concludes:

Now, if this or any other variety will fill the place of the Soulé in market, and escape the attack of the midge, it will surely be to our interest to raise such, and to make an effort to regain our reputation for "extra wheat," which has suffered sadly in the past few years by raising so much amber and red wheat. Of the 20,000,000 bushels grown in the State in 1868, probably less than 5,000,000 would pass as extra, and at fifteen to thirty cents per bushel difference in price, it will be seen that in the aggregate this is an item of no small importance to Michigan farmers; for, if a man raises five hundred bushels of wheat, and loses fifteen cents per bushel, (the difference in our market between the best Treadwell and Deihl, Soulé, or Tappahannock,) he loses $75, or enough to buy seed of a better variety.

An experiment with Tappahannock and Treadwell in Hillsdale County

resulted as follows: Four measured bushels of Tappahannock were sown on a well-prepared soil, of moderate fertility, at the rate of one bushel to the acre; by the side of it, and treated in the same manner, the Treadwell was sown at the rate of one and one-third bushels to the acre. The Tappahannock ripened and was cut two weeks earlier than the Treadwell, producing twenty-nine bushels to the acre. The Treadwell, with a much heavier straw, yielded twenty bushels to the acre, showing forty-five per cent. in favor of Tappahannock.

Hon. J. Bidwell, writing from Chico, California, says:

Everything considered, the Tappahannock is the best wheat of three kinds experimented with. With careful cultivation on our best soils, the yield may go to fifty and even to sixty bushels per acre.

ARNAUTKA WHEAT.

This variety of spring wheat was introduced into this country by the Department in 1864, having been purchased in Odessa, Russia. It has been distributed annually since that year, and has steadily grown in the estimation of wheat culturists. It has been found to be an early and hardy variety, yielding heavily. The grain is fair and plump. In latitudes where the season of spring wheat growing is short, its early maturity is a valuable consideration. The average weight per bushel is sixty-two pounds. Some accounts of failure have been reported, but they are rare, and in several cases due to unusual seasons. In Pulaski County, Virginia, several farmers are reported as having failed to raise crops, but no special reasons are assigned, nor the mode of treatment given. One of them, however, concluded to try Arnautka as a winter wheat. Having sown in the fall, he was surprised to find that it filled out well and yielded heavily.

A few examples of successful culture will show the adaptability of this wheat to a variety of climates in this country.

A farmer writing from Hancock County, Maine, says:

The Arnautka is the handsomest wheat ever seen in this vicinity, and is peculiarly adapted to our soil and climate; in fact, the quality of the wheat surprises every one. I much doubt if finer wheat is produced in any of the Western States.

In Sagadahoc County, four quarts of the Arnautka, sown May 1, on rocky soil, on which corn had been raised the year before, ripened eight or ten days earlier than other spring wheat sown at the same time, and produced two and one-half bushels. In Addison County, Vermont, four quarts, sown May 1, harvested the second week in August, yielded about three bushels, or twenty-four fold. The soil was clay, plowed the year before, and lightly manured. The straw stood strong, heads heavy, and berry long and full. It is supposed that this variety will prove as valuable to that section of the country as did the Black Sea wheat, which was originally introduced from the same latitude. In Orleans County it proved as early as any variety. Three quarts yielded about two bushels. In Carroll County, New Hampshire, sixteen bushels were raised from one bushel, sown on corn land of an ordinary character, and without any special preparation by manuring. It was reaped like ordinary grain, no care having been taken to save all the heads. The heads were not long, but the kernels were large and fully developed. In Steuben County, New York, seed sown in the first week of May was harvested August 23, yielding twenty-one bushels to the acre. Ten pounds sown in Rock County, Wisconsin, yielded nearly four bushels of seed fit for sowing. Eight pounds sown in Pierce County April 26,

threshed September 20th, produced three hundred and ten pounds of excellent wheat. A correspondent in Lincoln County, Illinois, reports a yield of thirty bushels to the acre, at least two weeks earlier than the Italian spring wheat sown at the same time. Another correspondent, writing from the same county, reports a product at the rate of fifty bushels to the acre for two successive seasons. A Grand Traverse, Michigan, farmer says that the Arnautka wheat is generally acknowledged to be the best variety ever seen there.

An Iowa correspondent, writing from Marion County, reports that nine pounds sown on the 10th of April yielded one hundred and sixty pounds of No. 1 wheat, weighing sixty pounds to the bushel. Floyd County, same State, reports a yield of ninety-six pounds from one pound and ten ounces of seed, sown on new land; a little more than sixty-fold. A farmer of Dixon County, Nebraska, reports a yield at the rate of thirty bushels to the acre; the grain being considerably larger than other varieties sown in his vicinity, and ripening four to six days earlier. In Douglas County, two bushels were sown on newly broken upland. It stood well throughout a long wet season, growing to a height of five and a half feet. The yield was at the rate of thirty-five bushels by measurement and forty bushels by weight to the measured acre. This variety seems to be well adapted to the climate of the great wheat-growing region of Minnesota. A Rice County correspondent gives the following account of a successful experiment:

> I received exactly eight pounds of the Arnautka wheat from the Department, which I sowed on the 27th of April, 1869. The ground was new breaking; consequently, the best for any kind of wheat in this part of the country. I sowed on the same day Scotch fife, on the same kind of ground, in order to see which would ripen first. The Arnautka was fit to cut about one week earlier than the Scotch fife. The straw or stem of the Arnautka is fully as strong as that of the Scotch fife. It is a bearded wheat, and resembles the "Hedge-row wheat," formerly raised in Illinois, except that the heads are much larger. The kernel of the Arnautka is unquestionably the largest that has ever come under my observation, and I have every reason to believe that it is one of the best kinds of wheat for large yield that has ever been introduced into this State. I think I can thresh about five bushels from the eight pounds sown. At this rate, the yield would be forty bushels from a bushel and four pounds of seed, or about sixty bushels to the acre, by sowing one and a half bushel. I think it will not do quite so well on old ground on which wheat has been raised for a number of years, but I do believe it will average fifty bushels per acre on any ground fit for any other kind of wheat.

A writer in the Prairie Farmer bears the following testimony as to the value of this variety:

> I received a sample of the Arnautka wheat from the Department of Agriculture in the spring of 1867, and was well pleased with the yield and the quality of the grain. I sowed it again in the spring of 1868, and had a bountiful yield. I had four bushels of it ground to test the quality of its flour, and am fully satisfied with both the quantity and quality, and, unless it changes materially for the worse, shall continue to raise it. It has produced at the rate of fifty bushels to the acre the past two years, and has been carefully examined by many of the farmers, grain merchants, and millers in this vicinity, who are all satisfied, from present knowledge of its qualities, that it is a valuable acquisition for wheat growers. A few weeks ago I carried to the mill one bushel of white Michigan Tuscan winter wheat, weighing fifty-eight and a half pounds; product of first quality flour, thirty-eight and a half pounds. One bushel of the Arnautka wheat, weighing sixty-two and a half pounds, yielded fifty-one and a half pounds of fine flour.

ENGLISH VARIETIES.

In the fall of 1868, the Commissioner purchased from parties in England three kinds of winter wheat, which had been recommended as superior varieties, viz., the Rough Chaff, the Talavera, and the Polish.

The Talavera was an Italian wheat, introduced into England, and grown successfully. The Polish originated in the country indicated by its name, and also flourished well in England. The kernels were fine and plump, and of unusual weight. These varieties were distributed for the purpose of experiment in many States of the Union, but they do not seem to suit the climate and soil of the country. They certainly have not fulfilled expectations, as reports have been almost uniformly unfavorable.

In the Southern States the Talavera variety has failed entirely, the seasons being too short to permit its coming to maturity. In South Carolina it rusted so badly as not to be worth harvesting. The English Rough Chaff failed also, on account of its late maturity and liability to rust. In Ocean County, New Jersey, the heads produced were poor, the grains shriveled and imperfect, the seed had been sown thinly on a clay loam, which had been well manured; other wheat near, sown at the same time and treated in a similar manner, produced more than the average of excellent grain. In Cumberland County, Virginia, it proved a failure, while Red Purple stem, growing on either side, yielded a fine crop. In North Carolina it only partially matured, and in South Carolina, where treated in all respects like the Tappahannock, it proved three weeks later than this variety, and rusted so badly that the heads did not fill and the product was valueless.

A Washington County (Ohio) correspondent incloses a few heads of Rough Chaff, produced from seed furnished by the Department, and speaks as follows of the experiment:

I feel much disappointed at the result. It promised well until about the 20th of June, from which time it seemed to remain for several days without change, except growing a little dull in color—my other wheat turning quite yellow. On examining it, I found that the stalk appeared to be dead and the grains filled as you will see. I discovered no rust upon the stalk or blade. I regret very much that so fine a wheat should fail here. The stalks were rather short, but large, and stood erect.

In some portions of New York the Polish wheat seems to have done comparatively well. In Steuben County, where sown on new ground, it yielded twenty-four bushels to the acre. A good crop is reported in Broome County. On very rich land in Chautauqua County the growth was rank, but the wheat lodged and was struck by rust, so that it amounted to nothing. In Suffolk County the product was about equal to that of the Bearded Red wheat. Reports from Virginia, West Virginia, and Southern Illinois indicate that this variety is not early enough for those latitudes.

Hon. John Bidwell, of Butte County, California, reports the following experiments with wheat received from the Department:

Variety.	When sown.	Quantity sown.	Area sown.	Yield.
		Pounds.	*Sq. rods.*	*Bushels.*
Tappahannock	Jan. 27, 1869	46½	169.24	23.223
Rough Chaff	Jan. 27, 1869	7½	40.02	6.100
Talavera	Jan. 28, 1869	6	18.80	4.016

That is, the Tappahannock was sown at the rate of forty-four pounds to the acre, and yielded at the rate of 21.96 bushels per acre; the Rough Chaff, sown at the rate of thirty pounds to the acre, yielded at the rate of 24.38 bushels per acre; and the Talavera, sown at the rate of fifty-one pounds to the acre, yielded at the rate of 34.18 bushels to the acre.

The result of an experiment with three varieties on the farm of the Agricultural College of Pennsylvania, is thus tabulated:

Variety.	Weight per bushel.	Bushels of grain produced per one-eighth of an acre.		Gross yield per one-eighth of an acre.	Weight of straw per one-eighth of an acre.	Weight of grain per one-eighth of an acre.
	Lbs.	*Bush.*	*qts.*	*Lbs.*	*Lbs.*	*Lbs.*
Tappahannock	64	3	5	576⅜	374⅜	202
Talavera	53	1	21½	400½	312	88½
Rough Chaff	49½	1	1½	331	279¼	51¾

EXCELSIOR OATS.

The Excelsior oats, first distributed by the Department in the spring of 1868, were purchased in Bristol, England. They were grown in Somerset County, where they were remarkable for early and prolific yield and weight. These oats are white and handsome, and have been successfully raised in different latitudes of this country, losing none of their excellence by transfer from their native soil. The average weight per bushel is forty-nine pounds. Perhaps no new variety introduced in this country has given so general satisfaction, or such promise of material appreciation of the quality and quantity of our oat crop.

Levi Bartlett, of Warner, New Hampshire, has experimented with different varieties of oats during the year, and pronounces in favor of the Excelsior. The Norway oats weighed thirty-four pounds to the bushel, the Excelsior, forty pounds. Unfortunately, a large part of the land upon which these oats were sown was very sandy and suffered severely from the drought. Those in the sandy soil grew only twelve to eighteen inches high, while on a compact and moist soil they grew four to over five feet in height. Those on the dry portions were harvested six to nine days earlier, the kernels being small and light. A correspondent of the Department, writing from Dunbarton, New Hampshire, reports that three quarts and one pint, sown broadcast on land with which no extra care had been taken, produced two hundred and twenty-six pounds. The stalks were very large and heavy. In some cases a single seed sent out as many as fourteen stalks. The oats were very large and plump and thin hulled, the straw free from rust or mildew, while oats of the old varieties, in the same field, were nearly destroyed by these causes. An Oxford County (Maine) correspondent considers this variety far superior to any other yet grown in that section. Three quarts, sown May 10, on intervale soil, in fair condition, made a fine growth, standing five and one-half feet high, without any disposition to lodge. They were cut August 18, and yielded three bushels and four quarts, of superior quality, weighing forty-four pounds to the bushel. The secretary of the Wilmington (Vermont) Agricultural Society says the Excelsior oats yielded at the rate of sixty-six and one-fourth bushels per acre, weighing thirty-eight pounds to the bushel. They ripened ten days earlier than the common varieties, and eighteen days earlier than the Norway oats. He is of the opinion that they are the most valuable oats ever grown in the State. Seed was used at the rate of two bushels to the acre.

A farmer of Broome County, New York, reports that he sowed seven

quarts in a sandy loam soil, which had been manured and planted in corn the previous year. The land was a river plat, twenty rods of which were devoted to the experiment. The grain was cut August 12, and threshed in December, yielding four and a half bushels; weight, thirty-five pounds to the bushel; or thirty-six bushels to the acre by measurement, and about thirty-nine and a half bushels by weight.

In Herkimer County, the seed sown on good gravelly soil yielded well, the crop weighing forty-one pounds to the bushel; straw vigorous and strong. From five pounds sown in Oswego County there was a return of four bushels.

The yield in Tioga County, Pennsylvania, proved excellent, the grain ripening in ninety days from the date of sowing; weight, forty pounds to the measured bushel. Hon. R. J. Haldeman, writing from Dauphin County, says:

The Excelsior oats which I distributed have been verbally reported to me as having done admirably. Different parties have told me that their pound of seed produced nearly four bushels, and that they will weigh about fifty pounds per bushel. This is excellent for our valley, where, in recent years, the oats have not ranged over twenty-five pounds to the bushel.

In Cumberland County the Excelsior oats came up promptly, grew vigorously, and produced a stiff, tall straw, with a large yield of heavy oats, which took the highest premium at the county fair.

An experimenter in Kent County, Delaware, sowed one and one-eighth bushel on one-eighth of an acre, fairly improved. The yield was eight and one-quarter bushels, equal in all respects to the seed sown. The seed was sown at the rate of two bushels per acre, the yield corresponding to sixty-six bushels per acre. He says:

With our common white, or mixed black and white oats, we realized as the best crops not over thirty-five or forty bushels per acre, while the weight per bushel would not average over twenty-eight to thirty pounds. The product from my Excelsior seed averaged thirty-eight to thirty-nine pounds to the bushel.

In Wood County, Ohio, the Excelsior grew a foot higher, and gave a much larger product, than the oats usually sown in that county.

In Wayne County, one quart sown on a clay and loamy soil yielded five bushels and twenty-five pounds, weighing forty-two pounds to the measured bushel.

Several counties in Illinois return favorable accounts of experiments; also, several counties in Indiana.

A Perry County, Missouri, correspondent says that this variety has more than fulfilled all the expectations entertained of it, yielding on good upland over eighty fold, and producing a heavier grain than the original seed. Sown on bottom land the yield is lighter and the grain smaller.

In St. Louis County, seed sown April 9 on new bottom land was harvested July 14, yielding sixty-four fold. The stalks stood over five feet high, and were unusually stout, showing no disposition to lodge.

In Hennepin County, Minnesota, the Excelsior yielded sixty-five bushels of superior oats to the acre. The correspondent regards this variety as a valuable acquisition, and altogether worthy of its name.

An experiment made on the farm of the Michigan State Agricultural College is reported as follows:

Thirty-four pounds of Excelsior oats were sown broadcast on 36-100 of an acre, April 30, the grain weighing at the rate of forty-seven pounds per bushel. The crop was harvested August 5, and threshed August 18; weight of grain, seven hundred and two pounds; straw, one thousand and fifty-eight pounds. One bushel weighed 35.7 pounds. Yield per acre, by weight, 60.6 bushels. Ratio of straw to grain, 1.51 to 1. The soil was a sandy loam. The preceding crops were Swedish turnips in 1868, and corn in 1867.

In Jackson County a yield of fifty-nine bushels to the acre is reported, weighing thirty-nine pounds to the bushel. The crop was cut five days before other oats sown on the same day.

WHITE SCHÖNEN OATS.

The White Schönen, or Beautiful, oats were purchased by the Department in Hamburg, Germany, and distributed in the spring of 1868. This variety is a native of Sweden. The grain is plump and very handsome, the heads large, and the straw stiff and strong. It is not so early a variety as the Excelsior, but is, perhaps, quite as prolific. Owing to the brief period which has elapsed since these oats were given out for experiment among farmers, reports have not reached the Department from as many portions of the country as would warrant a positive statement as to their adaptability to our diversified soil and climate.

The Michigan State Agricultural College experimented with them in the growing season of 1869, on sandy loam. The seed was sown April 26, in drills, on 78-100 of an acre, and weighed at the rate of forty pounds per bushel. The crop was harvested August 2; weight of grain, 155.5 pounds; weight of straw, 210.5 pounds. One bushel weighed 37.5 pounds. Yield per acre, by weight, 62.3 bushels. Ratio of straw to grain, 1.35 to 1.

In Tioga County, Pennsylvania, they proved to be ten days later than the Excelsior.

This variety has been pronounced "valuable" in New York, Pennsylvania, Maryland, West Virginia, Illinois, Wisconsin, Michigan, Missouri, Kansas, and Nevada. A correspondent in Whiteside County, Illinois, reports a yield of seventy-five bushels to the acre. In Bay County, Michigan, a crop weighed forty-six pounds to the bushel. In Esmeralda County, Nevada, this variety is reported as superior to any previously grown in the State. The secretary of the Wilmington (Vermont) Agricultural Society reports that the White Schönen yielded at the rate of one hundred and four and seven-eighths bushels per acre. The crop matured ten days later than the common oats, but not too late for the climate.

A report from Dauphin County, Pennsylvania, pronounces this a remarkably fine variety, yielding largely, and weighing nearly forty pounds to the bushel.

OTHER VARIETIES OF OATS.

Samuel Donaldson, of Atchison, Pennsylvania, reports, under date of November 30, 1869, the following experiment with the White New Brunswick oats:

> Two years ago last April I received one pint of New Brunswick oats from the Department of Agriculture, from which I realized one-half bushel. In the spring of 1868 I sowed these, and received fifteen bushels. The fifteen bushels were sown last spring, and this fall I threshed three hundred bushels of as good oats as I ever saw, weighing forty-five pounds to the bushel. The grasshoppers eat off at least fifty bushels before harvesting. The fifteen bushels were sown on six acres which had been broken up the year before and planted in corn.

A farmer of Ottawa County, Michigan, is sanguine that he can, with careful cultivation, raise from fifty to sixty bushels per acre of this variety.

Hiram Capron, of Paris, Ontario, says of the White Somerset oats, received from the Department:

> They were sown on dry, warm land, and yielded seventy bushels; there was some shrinkage, or the yield would have been greater. It was the handsomest field of oats

I ever saw. They were sown thin; but from five to twenty stalks shot out from each seed. The straw was large, standing about five feet high.

In Montrose County, Pennsylvania, one quart of the Somerset oats yielded two and a half bushels by weight, forty pounds per bushel by measure.

EXPERIMENTS WITH OATS AND BARLEY.

The following valuable experiments are reported by the president of the Agricultural College of Pennsylvania:

The oats and barley received from the Department of Agriculture in the winter and spring of 1868–'69, were committed to William C. Huey, assistant superintendent of the Central Experimental Farm connected with the college, for trial upon the experimental plots, each of which contains exactly one-eighth of an acre. The results, abstracted from his interesting report, are given in the following table, showing the time of sowing, cutting, and housing, and the product in pounds in the sheaf and in the grain:

PLOT NO. 105—EXCELSIOR OATS.					PLOT NO. 106—EXCELSIOR OATS.				
Sown.	Cut.	Housed.	Product, pounds.		Sown.	Cut.	Housed.	Product, pounds.	
			Sheaf.	Grain.				Sheaf.	Grain.
April 14.	July 30.	August 2.	700	257	April 14.	July 30.	August 2.	690	260
PLOT NO. 501—EXCELSIOR OATS.					PLOT NO. 503—WHITE SCHÖNEN OATS.				
May 3.	July 30.	August 2.	725	237	May 3.	July 30.	August 2.	780	257
PLOT NO. 505—SOMERSET OATS.					PLOT NO. 502—SAXONIAN BARLEY.				
May 3.	July 30.	August 3.	525	206	May 3.	July 30.	August 2.	650	192
PLOT NO. 504—PROBSTIER BARLEY.					PLOT NO. 104—COMMON FOUR-ROWED BARLEY.				
May 3.	July 30.	August 2.	520	170	April 12.	July 30.	August 2.	505	209

From this table it will be noted that the several varieties produced at the following rates per acre:

Excelsior oats, plot 105, 64¼ bushels per acre.
Excelsior oats, plot 106, 65 bushels per acre.
Excelsior oats, plot 501, 59¾ bushels per acre.
White Schönen oats, plot 503, 64½ bushels per acre.
Somerset oats, plot 505, 51½ bushels per acre.
Saxonian barley, plot 502, 32 40–47 bushels per acre.
Probstier barley, plot 504, 29 bushels per acre.
Common four-rowed barley, plot 104, 35 27–47 bushels per acre.

The White Schönen oats matured later than the other varieties, and were cut a few days before they were fully ripe. This variety and the Excelsior are likely to prove very valuable additions, and the Commissioner of Agriculture is entitled to the thanks of the community for their introduction.

D. A. A. Nichols, of Westfield, New York, says:

I sowed eight quarts of the Excelsior oats the first week in May on ground plowed the previous fall. Soil, a strong clayey loam. They were sown at the rate of two bushels per acre, and harrowed in thoroughly. On the same lot, with only a small strip of barley between, I sowed the common black, or horse-mane, oats, at the same rate per acre, the soil being apparently the same in both pieces. Both kinds were harvested alike and threshed with a flail. The yield was as follows:

Excelsior, 8 pounds sown, 245 pounds yield.
Black, 160 pounds sown, 1,536 pounds yield.
Excelsior yielded, by measure, 7 bushels.
Excelsior yielded, by weight, $7\frac{2}{32}$ bushels.

Black yielded, by measure, 48 bushels.
Black yielded, by weight, 48 bushels.
Excelsior seed sown weighed 51 pounds per bushel.
Black seed sown weighed 32 pounds per bushel.
Excelsior yielded per pound, sown, $30\frac{5}{8}$ pounds.
Black yielded per pound, sown, $9\frac{6}{10}$ pounds.
Weight of crop per bushel Excelsior, 35 pounds.
Weight of crop per bushel black, 32 pounds.

By the foregoing it will be seen that, although the weight of the Excelsior oats was reduced about one-third, the result was good, showing that even in poor seasons the Excelsior oats will be a decided acquisition to the value of the crop. The straw was stiff and large enough to hold up the heavy heads; not, however, so coarse as the so-called Norway oats grown in this section, and therefore more valuable as forage.

BARLEY.

Of the several kinds of barley disseminated by the Department, the Saxonian variety seems to be the favorite. In Dauphin County, Pennsylvania, it did exceedingly well, and was pronounced to be a variety worthy of the widest distribution. The secretary of the Deerfield, New Hampshire, Farmers' Club, says:

It is the opinion of those gentlemen who have experimented with Saxonian barley that it is a superior grain, and that its introduction will prove of great benefit to this part of the State. This variety, and also the Probstier, were for the first time distributed during the present year, and for that reason few reports of experiments have been made to the Department.

EXCHANGES WITH FOREIGN SOCIETIES.

The establishment of a system of book exchange is a matter of years. Corporations and societies are slow in movement, and it takes time to secure, from those who are disposed to exchange, the regular transmission of their publications. Societies, to which the issues of the Department for 1867 were sent, are only now responding. On this account, the list of 1868, published in the Annual Report for that year, has been diminished only by the number of correspondents who have distinctly declined the propositions of this Department. Next year such societies as received the reports for 1867 and 1868, and still fail to respond, will be dropped.

Of the three hundred and twenty-seven societies to which the Annual Report for 1867 was transmitted, one hundred and twenty-eight have responded; many by sending sets of their publications, covering a series of years. Of the same number, ten have declined to exchange upon various grounds, and have been dropped from the list.

The accessions to the library during 1869, from all sources, were, exclusive of periodicals proper, one thousand one hundred and ten volumes, which may be classified as follows:

Agriculture proper	304
Horticulture	59
Natural History, including Botany, Zoology, and Geology	327
Meteorology	95
Statistics	101
Chemistry	29
Miscellaneous, and books of reference	195
Total	1,110

The larger number of the above have been received by exchange, the

limited appropriation for the purchase of books having been mainly devoted to the acquisition of botanical works, large works of reference, and foreign periodicals of scientific character, all of which are expensive.

Of the Annual Report for 1868, six hundred and four copies, and of the Monthlies for 1869, two hundred and fifty copies, have been sent out to foreign societies, distributed as follows:

COUNTRIES.	Societies which rec'd Annual, 1867.	Societies which have responded.	Societies which rec'd Annual, 1868.	Societies dropped in 1869.	Societies added to list in 1869.
Africa	2	2	4	.....	2
America, excluding North America	6	3	14	.....	8
Asia	3	3	12	.....	9
Australia	4	2	9	.....	5
Belgium	8	4	16	.....	8
Denmark	10	4	12	.....	2
France	44	7	72	2	30
Germany, including Austria and Prussia	153	60	262	5	114
Great Britain	27	7	68	2	43
Holland	17	7	25	.....	8
Iceland	.....	.....	1	.....	1
Italy	13	7	24	.....	11
Norway	2	2	8	.....	6
Portugal	1	.....	2	.....	1
Polynesia	1	.....	1	.....	.....
Russia	13	4	32	.....	19
Scandinavia	1	.....	1	.....	.....
Spain	3	2	4	.....	1
Sweden	6	2	11	.....	5
Switzerland	13	11	25	1	13
Turkey	.....	1	1	.....	1
Total	327	128	604	10	287

THE JENEQUEN, OR SISAL HEMP.

The inhabitants of Yucatan justly consider the *jenequen*, or Sisal hemp of prime importance among the staple articles of their native agriculture, because its valuable fiber not only answers an almost unlimited number of domestic purposes, but also supplies the demands of foreign commerce. Though the annual yield of the raw material may be said to be never failing, and has been always cultivated extensively, it has never been produced in sufficient quantity to meet all the demands from abroad.

While other products of Yucatan agriculture may occasionally have become unprofitable, either in consequence of adverse climatic features, to which the peninsula is subject, or through commercial freaks in the world's market, the *jenequen* has never been subject to such drawbacks, a fact attributable to the universal usefulness of its fiber and the unconquerable vitality of the plant, which easily survives the effects inherent to the nature of a riverless, rocky desert, and the severe trials of a six months' tropical sun. For a knowledge of the *jenequen* plant, its culture and uses, Yucatan is indebted to the Maya Indians, the direct descendants of those remnants of the Toltecs who, after the fall of their empire in the valley of Mexico, emigrated to Central America and Yucatan. The docile and industrious habits of this ancient race are to this day identical with those of the Mayas, whose vitality under the most severe trials has scarcely a parallel in the records of human civili-

zation. The *jenequen* plant may therefore be considered as truly emblematic of the character of the hardy and industrious Maya nation. Armed solely for defense, the plant, as well as the race originating its culture, must be regarded as alike harmless and useful.

The fact that the increased production of *jenequen* fiber results from the enterprise of the white rulers of the peninsula is readily explained by the workings of our commercial age under the sway of Neptune's all powerful trident. It is, however, worthy of notice that the Mayas, long before the discovery of America by Columbus, were not blind to their interests in foreign intercourse, which was cultivated with the interior of the American continent, as well as over the greater portion of the Antilles. This historical fact finds additional proof in well known philological researches by which the Maya language and its closely related dialects have been traced all over the area mentioned.

Yucatan agriculture recognizes the following seven species and varieties of the *jenequen* plant, each of which is known by a specific vernacular name:

1. The *chelem* (pr. Tshelem) grows spontaneously all over the land, but finds its favorite range on the barren, rocky districts of the northwest, with their border of maritime sand-flats. The botanical affinities of this plant so closely agree with those of *Agave angustifolia*, that it may be safely referred to this species. Popular estimation classes the *chelem* fiber as of prime value, on account of its naturally white, fine, heavy, and peculiarly strong texture. In regard to quantity it would not yield to the *sacci*, (pr. sacqui,) a variety which is more generally cultivated, because of its larger size, in which respect it excels all others. It is, however, stated that the *chelem* would equal the *sacci* in this respect, if the same care and attention were paid to its cultivation. Señor D. T. Mendiburn, of Motul, planted three hundred young sprouts of each, adjoining, on his estate, in the Island of Cozumel, and the result of his experiment proved that the *chelem* is of the same rapid growth, producing at the same time an equal quantity of fiber of superior quality. Señor M. also states that the transplanting and nursing of the *chelem* requires, in general, less care and experience than the *sacci*.

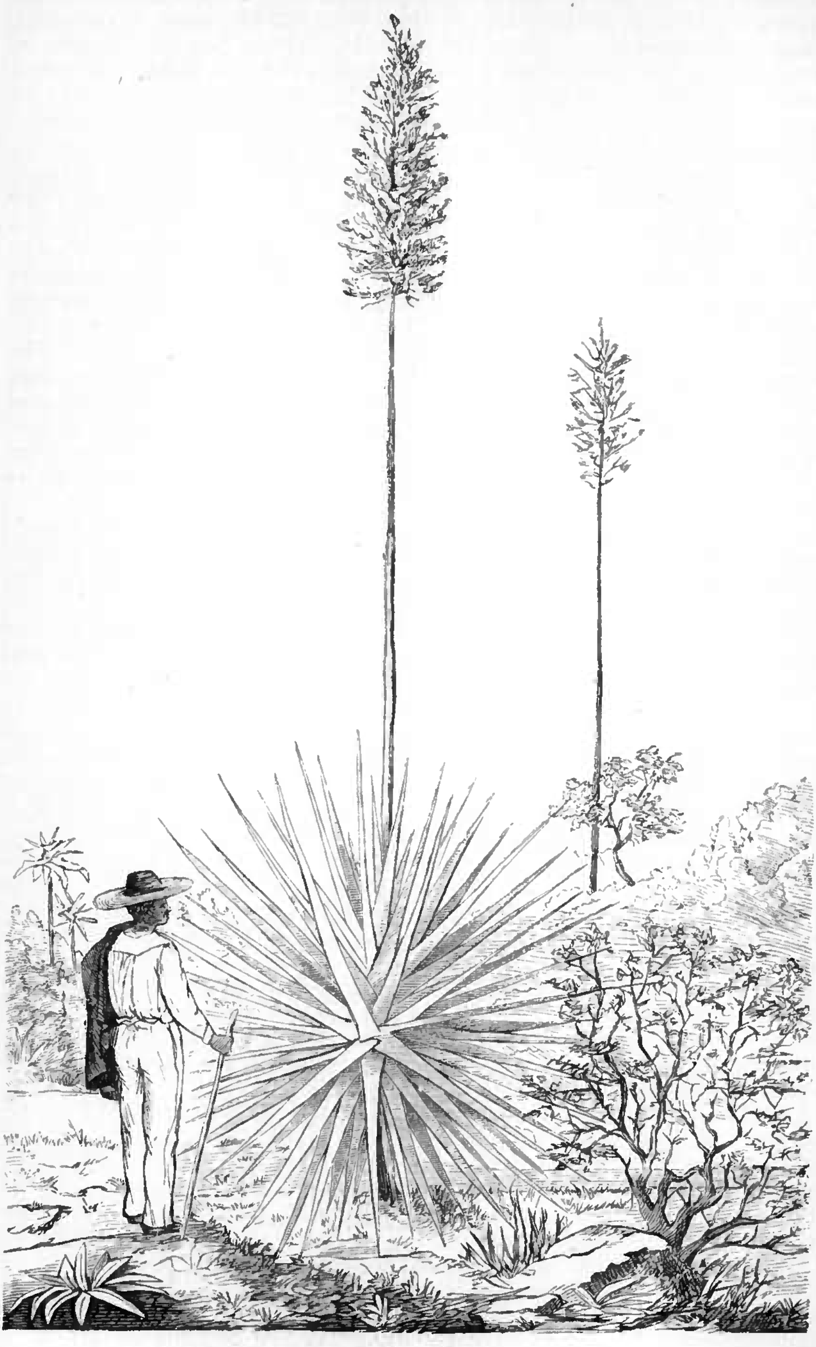
2. As to the qualities of its fiber the so-called *yaxci* (pr. yaashki) comes next. The name of this plant signifies green or green-leaved agave, the word being formed by *yax* green and *ci* agave. Its leaves, unlike those of all other varieties, the names of which have the word *ci* appended, are of a bright, velvety green, and are not covered with that glaucous, waxy bloom peculiar to the other varieties. The *yaxci* leaf is shorter, and consequently produces less fiber, but it excels in fineness, softness, flexibility, and lustre, and commands a much higher price in the market. The range of the *yaxci* appears to be limited, and its cultivation is confined to the more genial soil and climate of the eastern and southern parts of the peninsula, where it is mostly raised upon what is known as sugar land. At the present time Valladolid, Chemax, Tijosuco, and Bolonchen are the principal places where the *yaxci* is to be looked for. The fiber of this variety is almost exclusively used for the finest fabrics and articles of luxury. One small specimen in the shape of a tassel is now deposited with the collection of *textile fibers* in the museum of this Department. Persons experienced in matters relating to the *jenequen* maintain that the *yaxci* could be equally well cultivated on the extensive sand-flats along the coast, though a trial has never been made.

3. Third in order is the *sacci*, (saci or saqui, as the Spanish write it.) Sacci means white agave, the name being formed by the prefix *sac*, white.

PLATE XXIII.

THE SACCHI.

PLATE XXIV.



THE CAJUN.

The leaves of this variety are densely covered with a white, waxy bloom, somewhat like that of the cabbage; hence its specific name. The *sacci*, though cultivated throughout Yucatan, appears to have its center of production in the northwestern part, otherwise known as the district of Merida. The white, flexible fiber, which the large leaves of this plant produce in great length and abundance, makes this variety a *quasi* standard-bearer among its congeners. All that is exported, either as raw material or manufactured into various shapes, is said to be almost entirely furnished by the *sacci*, which annually yields, on an average, twenty-five leaves, the aggregate weight of which is one *arroba*, or twenty-five pounds, yielding an average of one pound of clean, marketable fiber.

4. Next in order is the *chucumci*, (pr. tshucumki.) The meaning of this name is not clear, for chucum is the name of one of the numerous species of *acacia* or *mimosa*, the bark of which furnishes, almost exclusively, the tanning material of the country, in lieu of oak bark. The *chucumci* much resembles the *sacci*, but the leaves of the former, though larger, yield a rougher and harder fiber, and are, therefore, considered inferior. Its less flexibility fits it only for coarser fabrics; still, in general cultivation, but little distinction is made between them. The range of its culture is over the rocky flats and sandy regions adjoining the coast.

5. More distinct from the *sacci* is the *babci*, (pr. babki or vavki,) which, seemingly of quicker growth, produces double the number of leaves, but of smaller size. Its fiber is stated to be of better quality, though not sufficiently so to overcome its quantitative deficiency.

6. Sixth in the list is the *citamci*, (pr. kitamki,) which name may be translated as pig or hog agave. The leaves of this variety are short and narrow, and equally poor in fiber. The plant is held in low esteem.

7. The *cajun* or *cajum*, (pr. cahun or cahum,) concludes the list of our *jenequen* varieties. This plant is, like the *chelem*, indigenous; and is found growing spontaneously through that littoral belt which immediately borders on the mangrove region. It is also met with occasionally in the interior of the peninsula, between the towns of Yzamal and Valladolid, and also southward on the table lands known under the inappropriate name of the Sierra. The botanical affinities of the *cajum* place it in the genus *fourcroya*, and there is little doubt that it is referable to *F. Cubensis*. It has large, thin, uniform leaves, of an agreeable green, four to five feet long, with margin armed with sharp, curved spines, like those of the *agaves*, or some of the heavier armed species of *bromelia*.

In order to obtain the fiber of the *cajum* the leaves have to be collected near the heart of the plant, when they are cut and parched over a light fire, by which process, according to Señor Mendiburn, the fiber becomes strengthened considerably, so that in this state the leaves are preferable as ties for thatching roofs.

A glance at the nomenclature of *jenequen* varieties shows that the first and the last have particular names, with which the monosyllable *ci* is not connected, and these two alone are known as indigenous forms, growing wild in the country. The word *ci* seems to apply collectively to all agaves in their cultivated or fiber-furnishing state, and is probably a synonym of *jenequen*, which originally belonged to the ancient language of Hayti. This is also one of the numerous instances, not only of the occasional adoption of foreign elements from one language into another, but also proving some intercourse between two distinct nations of which one is already extinct.

The word *jenequen* applies, as far as we know, more to the fiber in its unmanufactured state than to the plant which furnishes it. The names

having the suffix *ci*, connected and belonging to the various forms of *jenequen*, are rather artificial, and appear to have been expressly created to designate certain cultivated forms of one or two really original plants, mentioned above under the names of *chelem* and *cajum*. This is a popular view of the matter, and is also adopted, with every show of probability, by some of the native authors of the country.

In the *Estadistica de Yucatan*, published by the *R. Soc. de Geografia y Estadistica*, in Mexico, January, 1857, and written by the Señors J. M. Regil and A. M. Peon, it is expressly stated (p. 274) that the *yaxci* and the *sacci* have been derived, respectively, from the original and indigenous plants called *cajum* and *chelem*. These represent two different species and genera, the former being a *fourcroya* and the latter an *agave*. Whether this assertion would stand a full scientific test, we are not prepared to say. As to the *chelem* and the *sacci* there is little room for doubt, for they agree sufficiently well in their botanical characters, and exhibit only such divergences as are incident to a plant in its wild state on one side, and, on the other, to one which has undergone some modifications by cultivation.

Of the *yaxci* only a few fresh leaves have come into our hands, so that no opinion can be formed. The bright green color of its leaves is the one thing which particularly distinguishes this variety from all the others except the *cajum*, which is a *fourcroya;* but this species has the margin of its large ensiform leaves regularly armed with horny, curved spines, while the leaves of the *yaxci* can be said to be only subinerm, their occasional spines being interspersed with rough, granular excrescences. The more fleshy habit of the *yaxci* may be the result of cultivation, as is the case with the *sacci* and the closer related forms of this variety.

The large area cultivated, and the corresponding quantity of fiber furnished by the *sacci* and some of its co-ordinate varieties, make these plants, collectively called *jenequen*, by far the most important agricultural staple of Yucatan, excluding even the breadstuffs in the shape of maize, beans, rice, &c. The dry climate of a peninsula, washed on all sides by the currents of two heated tropical seas, and the bare, rocky flats constituting the main-land of Yucatan, seem to be co-operating agencies in forming excellent fiber, which may be called a specialty of the country.

During the period from 1860 to 1866, when the United States did not furnish the usual supply of cotton, the culture of this article threatened to become a serious rival of *jenequen* in Yucatan. On account of the enhanced price of the former, a considerable portion of land and labor was diverted to the production of cotton, but the lessons of a few seasons were sufficient to prove the fallacy of the cherished expectations of this staple. It was soon found that cotton is a much more tender plant than *jenequen*, and that the latter is more able to brave the severities of climate and soil peculiar to Yucatan; even the fruticose or arborescent nature which the cotton plant assumes within the tropics, cannot sufficiently fortify it against the alternation of rain and drought, continuous for six months. To meet these climatic conditions, the *jenequen* seems to have been particularly created; the shape and nature of the plant exhibit the exact expression of passive resistance, by which it opposes the effects of a scourging, tropical sun, and the almost entire absence of water on the surface of a riverless country. Heated air and glaring light from above, and the calorific rays reflected from burning, rocky ledges beneath, seem to comprise everything required for the most genial development of the *jenequen*, which seldom fails to make grate

ful returns for the little labor bestowed upon it in keeping it free from weeds and noxious animals.

The profits of *jenequen* culture are said to reach ninety-five per cent. per annum on the capital invested, while maize usually pays only seventeen per cent. and rice about twenty-four per cent. These seemingly high figures in favor of the *jenequen*, though we have not the means at hand to verify them, do not appear to be exaggerated. The first outlay is not larger than that required for the production of maize, rice, or beans; and though *jenequen* yields no return the first four or five years, the crops of maize and beans gathered during that time from the young *jenequen* fields compensate for what might seem loss of time. A *jenequen* field commences to yield in the fourth or fifth year after being stocked, and continues to do so for fifty to sixty years and even longer.

Each plant, during this time, furnishes annually an average of twenty-five full-grown leaves. These yield, under the ordinary rasping process, one pound of clean, marketable fiber, worth at the shipping port of Sisal an average of $1 50 per arroba of twenty-five pounds.

One mecate, containing five hundred and seventy-six square varas,* stocked with sixty-four *jenequen* plants, annually yields an average of sixteen hundred ripe leaves, which furnish together sixty-four pounds of clean, marketable fiber, at an average value of $3 84. For this product the following expenses are required: For weeding the field five times, at 18 cents per day for one hand, 31 cents; cutting and bringing in sixteen hundred leaves, 12 cents; rasping, bleaching, storage, and transportation to market, $1 28; total, $1 71; leaving a net balance of $2 13 per mecate, or about $13 20 per acre. In this statement the items of ground rent and wear and tear of tools are omitted as too trifling for for consideration. The value of the preparatory labors bestowed upon a new *jenequen* field amounts to about fourteen cents per mecate.

The presence of water for domestic purposes establishes the only scale on which the value of soil can be estimated.

In growing *jenequen*, and preparing its fiber, no tools, besides an iron weeding hook, are used which could not readily be made by joining four or five sticks. The low price of agricultural labor in Yucatan may appear almost incredible to those not familiar with the habits of the rustic population. The sole diet of these people, especially those of the pure Indian race, consists of maize, prepared in various forms. Add to this the *chile*, or red pepper, and an occasional spare cent for rum, and they seldom if ever desire animal food.

The profitable results of *jenequen* culture at an early date invited the attention of the land proprietors, mainly of Spanish descent, and in order to expand this remunerative branch of agriculture the assistance of mechanical labor was soon called for. The slow and tedious work of rasping the leaves by hand needed to be replaced by machinery.

In 1833, H. Perrine, then United States consul at the port of Campeche, invented an apparatus for rasping and cleaning *jenequen*. Its apparent success in the beginning secured for it a patent from the legislature; but it was soon found that the knives employed, owing to the peculiar shape of the leaf, cut too much on one side, working the other side imperfectly. A second trial was made in 1847, by J. R. Hitchcock, who carried his machinery to Merida, taking with him an engineer to make any repairs or corrections required. His first trials, however, proved the machinery inadequate to the requirements, as it destroyed too much fiber, and otherwise worked unsatisfactorily.

* 33.3852 English inches.

Soon after, Mr. Hitchcock invented another apparatus, which, after slight modifications, worked well. The inventor, however, lost his premium of $10,000 through the overthrow of the government, by one of those revolutionary movements which are the chronic disease of Spanish America. Afterward a Mr. Thompson, of Boston, also accompanied by an engineer, tried his fortune with a different apparatus, but still less success crowned his labors.

Here a sudden break in the thread of statistical data brings us immediately to the present day, where we find various steam-engines in operation, not only for rasping and obtaining the raw material, but also for spinning and twisting the fiber into cordage. Several of these engines are now working at Chimay, one of the finest and best equipped haciendas of the country. One of the largest machines in use bears the stamp of the Paterson Works, New Jersey.

The engineering hands having charge of these machines are Indians, or half-breeds, who fill their places to the satisfaction of their employers. In the suburbs of Merida several establishments are in full operation, and at present there appears no prospect of any check to the large production and preparation of Sisal hemp.

For those specially interested in the cultivation of the *jenequen* plant, the following notes are presented:

PREPARATION OF A JENEQUEN FIELD.

After making the selection of land it should be fenced in substantially, either by brushwork, eight feet in height, or by a stone wall of five feet. This done, the wood, trees, and brush should be chopped down in August, the trunks of the trees being made to fall as flat to the ground as possible, to facilitate their subsequent destruction by fire. This burning process needs to be repeated two or three times to prevent growth from the root-stalks. The ground can then be cropped with maize, beans, or similar products, either of which will make a good return, especially if the ground has been well moistened with rain before receiving the seed. Weeding is also to be attended to. Little labor is required for this work, however, as it merely consists of cutting the herbage, uprooting being unnecessary after the ground had been thoroughly burned. The following year the field can be again used for a similar crop after preparation by knife and fire. Necessary repairs of the fencing should also be looked after. Circumstances permitting, it would be well to prepare the field a third time for a like crop, after which the ground will be found in excellent condition for sticking with young *jenequen* plants.

PLANTING.

In April or May holes of nine inches diameter and eighteen inches deep are scooped out to receive the young shoots or plants. These holes are arranged in drills, the plants being placed three yards apart in each direction. Thus one square mecate, measuring five hundred and seventy-six varas, will hold sixty-four *jenequen* plants. Experts differ somewhat as to the space necessary for one plant. Señor J. D. Espinosa, a writer on the subject, suggests the division of a square, according to its size, into four, six, or eight lots, separated by alleys six yards wide, to facilitate the working of the ground as well as the gathering of the leaves and the taking out of the young shoots. Though the planting may be done at any time, the rainy season, from May to November, is preferable. The lower part of the young

plant must then be buried, the upper portion being kept in a vertical position by placing three or four small stones under the lower leaves, a precaution which seems more important for endogenous plants than for exogens. For this work the month of June, when a short interval of the rainy season occurs, will be found the most favorable time. After planting, horses may be pastured within the inclosure, which enables the shoots to take root vigorously. When not pastured weeding by hand must be resorted to during July and November; for, if the young plants are not assisted in this manner, a serious loss of time will be experienced in the end by a retarded reproduction of offshoots from the mother plants. If circumstances should not permit a thorough weeding, this work may be limited to a radius of one yard around each plant, the remaining space being merely cut by a scythe or sickle. The taking out of the young shoots for transplanting should be done after the fall of two or three good rains, that they may be removed with as many unimpaired roots as possible. It is also advisable to procure no more at a time than can be planted out the same day. By observing these simple rules an almost incredible advance will be experienced in the development of the young growth. The shoots should not be less than one-half, nor more than three-quarters, of a yard in length, experience having demonstrated that young plants of this size prove much more productive, both of fibrous leaves and propagating plants, which latter, after a lapse of three years, will furnish their first crop. If, on the other hand, grown plants are used for sticking a new field the stem becomes too thick, somewhat like that of the *piña*, (a species of *Bromelia*, probably *B. karatas*.) This is caused by the sluggish development of the roots, resulting in the languishing of the plant for many years. Señor Espinosa states that he set apart a small piece of ground in 1855, stocking it after the first rain in June with thirty-five young plants, none of them more than half a yard in length. No attention was paid to their taking root until three weeks afterward, when a free development of young leaves was perceptible. Careful weeding during that time prevented all entangling of vines or the growth of weeds. In the beginning of December he noticed the first budding out of young offsets, (*Pitones*,) of which he collected during the months of January and February one hundred and three plants from thirty-three mother plants. Many of these young plants measured nine inches in length, and were otherwise well formed, and exhibited a vigorous vitality, in which they rivaled even the mother plants. Only three out of thirty-five failed to produce young plants, though they had grown during the time as well as one could wish.

NURSERIES.

To promote prompt development of the young plants without drawing too much upon the powers of the mother plants by prolonged connection with them, nurseries are recommended. All the young offsets standing closer to one another than half a yard are taken out and placed in the nursery, one yard apart. Here weeding and rooting five times during one season are easily done. If to the nurselings, now deprived of maternal nourishment, is given the benefit of irrigation during the dry season, say once a week, their growth will be astonishing, while a great gain of time will be achieved. After attaining the height of about three-fourths of a yard the young plants can be set out for permanent growth. The domestic plan of accelerating the growth of the young plants, dictated, as it were, by the interest of man, seems also to be indicated by

nature herself, for most species of *Agave* exhibit a marked propensity for viviparous habits—so much so that one of them received the systematic name *A. vivipara*, a synonym of *A. Antillarum*. The former name, however, appears not discriminating enough, because viviparousness is alike common with several other species of the genus, especially so with our *chelem*, (*A. angustifolia*,) and not less so with the cultivated varieties of this species. These plants are not only marked by a profuse reproduction by offshoots from the root, but also, in many cases, by an apparent monstrosity of their flowering scape, which produces, under certain circumstances, instead of flowers, so many young plants, in every respect as perfect as those having grown from the roots. This of itself is nothing strange, as it is of common occurrence with many endogens, and occurs regularly with some of our domestic plants.

Sacci, or the *chelem*, when its flowering scape becomes wounded or broken before the development of the blossoms, invariably produces young plants from the axils of the internodes of the scape, or above the points where naturally flowers should appear. Nature thus seems to have provided double security for the reproduction of the species.

The development of the flowering scape from the center of the plant, or the *cogollo*, as the Spanish call it, forewarns the termination of the existence of the mother plant. This scape, called by the Mayas *bob* or *boob*, if left undisturbed, attains a height of twelve to fifteen feet. When four to six feet high the *bob* should be taken off, as, if it should be permitted to complete its full growth and flowering, it would injure all the other plants in the immediate vicinity.

There are also flower-scapes which push out from their nodes young plants, which are entirely like those sprouting from the roots. These young shoots grow so rapidly that they become eight to ten inches long before the scape itself dries up entirely. Señor Espinosa once transplanted fifteen such shoots, which grew to the same size as those taken from the root, and to which they proved fully equal in quality and quantity of fiber, as well as in reproduction.

THE ENEMIES OF THE JENEQUEN.

The *jenequen*, especially in its cultivated state, has enemies of various kinds. All domestic animals, particularly horned cattle, hogs, and goats, and also deer, greedily devour the young plants, and, when driven by hunger, take even full-grown leaves, which they chew for the sake of the juice. An insect belonging to the genus *Scarabæus*—the Mayas call it *maax* (pronounced maash)—bores through the central portions of the plant and destroys the softer parts of the *jenequen;* while two other insects, called *cochol* and *kuxluch*, (pronounced cotshol and cooshlootch,) prey on the young leaves. Another obstacle to cultivation is a species of mouse, which feeds on the roots. To prevent the ravages of the *maax* there is no other remedy than to hunt it diligently morning and evening, removing it with a pointed stick, and filling up with pebbles and soil any wounds or holes on the plant caused by this beetle, to prevent rain-water from entering. Against the other insects there seems to be no remedy but searching for them regularly, especially during the rainy season.

Señor D. J. Gonzales, of Seyé, states that a small species of fox, called *päioch* (pr. Päiotsh) by the Indians, partly feeds on the *maax* and other *coleoptera:* and, hence, should not be persecuted. Whether this animal is really of the canine tribe we are unable to say. The setting of snares or traps seems to be the only way to prevent the noxious workings of the root-destroying mouse.

RASPING.

This process immediately follows the cutting and gathering of the mature leaves without any further preparation, and is generally done by hand, except where *jenequen* production is carried on upon an extensive scale. The two implements in use among the smaller producers are of Maya origin, and are known under the vernacular names *toncos* and *pacche* respectively.

They are of the most simple construction, especially the former, which consists of a thick smooth stick, about three feet long, resting with one end against the ground, with the other upon a support of two equally rustic sticks fastened in the ground, and inclining upward toward each other, so as to form a cross, in the axle of which the main stick rests. Upon the inclined plane of the latter the *jenequen* leaf is placed with its concave side down. While this is held firmly with one hand, the rasping work is performed with the other hand by means of a wooden fork, fitting the size of the leaf. Thus every particle of the epidermis and the juicy chlorophyl is scraped off, leaving in the laborer's hand at last a bundle of clean fiber, though still of light greenish yellow tint. This work is laborious, and cannot be continued by one hand longer than two to three hours. Three hours are generally allowed for the rasping of one hundred leaves, with a yield of one pound of fiber.

The loss of fiber in rasping averages five to ten per cent. The offal is generally a dead loss, though in some haciendas it is fed to cattle, the acid, gum-like juice particularly suiting their taste.

The *pacché*, (pr. pactshe,) also of Maya invention, seems to be one point less primitive than the *toncos*. The *jenequen* leaf is placed on an inclined board, one end resting against the body of the laborer, who does the rasping by means of a triangular piece of wood, one and a half foot in length, with handle on each end. The result of the work with the *pacché* is about the same as that with the *toncos*.

The fiber issues from either of the rasping processes clean and almost dry, and loses its impure tint by one or two days' exposure to the rays of the sun. For this last process light rustic scaffolds are constructed in the immediate vicinity, where the rasping is done. The bleaching finally ends the labors of the producer, as the fiber is now ready for the market.

The application of steam-power for rasping Sisal hemp, immediately induced by the growing commercial value of the article, naturally increased the culture as well as the manufacture of the *jenequen* in Yucatan. The principal district for this production is that of Merida, the aridity of the soil and climate of which favors the growth of the plant, while its greater population and better developed means of communication especially favored the extension of this branch of industry.

According to statistics, made up in 1845, the average annual consumption of *jenequen* fiber, raw and manufactured, throughout the peninsula, was 73,759 arrobas, worth, at the market value of $1 50 per arroba, $110,600 in round numbers. The exports for the same period amounted to $107,591.

Mr. Squier states that the total exports of *jenequen* to the United States in 1860 amounted to 5,630 hundred-weight, valued at $33,780; against 9,250 hundred-weight in 1854, valued at $55,500. The decrease noted is attributable to the civil commotion prevalent during that period in Yucatan. Should the same influences continue they will seriously interfere with the future production and manufacture of *jenequen*.

JENEQUEN CULTURE IN THE UNITED STATES.

There is little doubt that very considerable tracts of land in our Gulf States would be found suited to the production of *jenequen*, and the introduction of so important an agricultural staple would be the more desirable for the reason that arid land, so singularly adapted for raising Sisal hemp, would never justify the least outlay in money and labor for the raising of any other crop.

OTHER FIBROUS PLANTS.

Mention may be made of several other plants indigenous to Yucatan, producing a fiber which, though only occasionally manufactured, is known to possess qualities worthy of consideration.

Foremost among these are two species of *Bromalia*, viz: *B. karatas* and *B. pinguin*, both of Linnæus. Their fine, flexible, and exceedingly strong fiber goes usually under the name of *pita*, a term generally given throughout Spanish America to all fiber-bearing endogenous plants. In Yucatan *pita* of this species is produced in but small quantities, perhaps only for local use, not swelling the great bulk of *jenequen* proper.

The fiber of the banana trees (*Musa sapientum* and *M. paradisiaca*) also deserves notice. It is stated, however, that its preparation requires too much labor to justify a more extended manufacture for general use, in competition with *jenequen*. It is generally admitted that manila rope, a fabric of *Musa textilis*, is inferior in quality to that of the *Agaves* of Yucatan. As an article of beauty *Musa* fiber can scarcely be equaled except, perhaps, by that of the *yaxci*, of which mention was made as a *jenequen* variety.

A sample exhibited at an industrial exhibition in honor of the Empress Carlotta, then on a visit to Merida, was universally and justly admired for the velvety luster and soft flexibility of the material of which it was made, the fiber of the musa or banana tree. Not inferior in strength, if in luster and elegance, was a sample made of the fiber of a *byttneriaceous* weed, vernacularly called *chichiben*, (pr. Tshitshiben.) This is a species of *melochia*, and very similar to, if not identical with, *M. pyramidata*. The fiber of this plant, though void of the beautiful luster of the *musa* fiber, seems to excel all other fibers of the peninsula, without exception, in softness and flexibility, which peculiarities may yet make the *chichiben* of much more industrial importance than at present. Its habit of gregarious growth along roadsides, where it forms large and extensive patches, much facilitates gathering it, so that very little labor would be required for that purpose.

The fiber of certain palm fronds occasionally prepared in Yucatan presents a unique example of utilizing palm fiber.

These species are known in Yucatan under the vernacular names of *chit* (pr. tshit) and *nagasz*, both probably forms of the genus *Thrinax*, and perhaps referable to *T. humilis* and *T. argentea*. Their habitat is the littoral belt of extensive sand flats or downs adjoining and beyond high-water mark, and inside of the brackish water lagoons and mangrove thickets. The fiber is represented to be very strong and flexible, and is occasionally made into cordage, such as is used throughout Spanish America for lassoing wild cattle, horses, and mules, for which purpose tackle of great strength and smoothness is required. The fiber of the *chit* and *nagasz* is said to possess these qualities in a high degree. Both these palms grow spontaneously and in great abundance over the downs of northwestern Yucatan, where their fiber could be gathered in large quantities.

If a trial of propagating these two species of palm in similar localities in that portion of our southern coast which is washed by the Gulf stream should prove to be too slow, experiments might be made with some of our own palms which belong to the genera of *chamærops* and *sabal.* These genera are so closely related to that of *Thrinax* that even science has not yet succeeded in establishing conclusively the botanical distinctness of several of their forms.

RECENT FARM EXPERIMENTS.

INDIAN CORN.

FERTILIZERS COMPARED.

Professor Kedzie reports an experiment made with Indian corn at the Michigan Agricultural College. The land used was a very stiff clay, which had been in pasture for several years, and which had never been under-drained. The ground was prepared by plowing and harrowing, and rows were marked four feet apart. The treatment and results on nine plots, each comprising two rows of corn, are given. To each alternate plot the manures specified were applied, a shovelful in each hill, thoroughly mixed with the soil, before planting, which took place May 18. The composts employed were as follows: Swamp muck and leached ashes, in the proportion of five loads of the former to two of the latter; muck and quicklime slaked with water, in the proportion of five loads of muck to ten of lime; muck and quicklime slaked with a saturated solution of common salt, in the proportion of five loads of muck to ten of lime; muck and wood ashes, in the proportion of five loads of muck to one of ashes.

The product of the field was reduced by cut-worms, which, harboring in the old sward, attacked the corn at an early stage, and nearly ruined it, being most destructive in the fertilized plots. The corn was cultivated and hoed twice, cut up September 29, and husked when quite dry. The following is a tabulation of results:

Plot.	Dressings applied.	Corn, pounds.	Gain, pounds.	Gain, per cent.	Gain per acre, bushels.
1	No manure	126			
2	Muck and leached ashes	179	70	64	28
3	No manure	92			
4	Muck and lime slaked with water	148	37	33	15
5	No manure	130			
6	Muck and lime slaked with brine	153	28	22	11¼
7	No manure	120			
8	Muck and wood ashes	142	32	29	12¾
9	No manure	100			

The gain on each fertilized plot is calculated from the average of the adjoining plots not manured. According to the foregoing statement the yield per acre of plots 1, 3, 5, 7, and 9, not manured, was very nearly as follows: 50 bushels, 37 bushels, 52 bushels, 48 bushels, 40 bushels.

S. C. Pattee, of Warner, New Hampshire, reports an experiment made by him with various manures applied to corn. The land was a worn-out field which had received no manure for ten years previous. It

was plowed in the fall. The manures were applied in the hill, 14 pounds of each kind on 140 hills, except in the cases where different quantities are specified. E. F. Coe's superphosphate gave 151½ pounds of sound corn; hen manure mixed with an equal quantity of loam, one bushel of the compost to 140 hills, 144 pounds; the Cumberland Bone Company's fertilizer, 138 pounds; fish pomace dissolved in sulphuric acid and mixed with loam and ashes, 137 pounds; Rhodes's ammoniated fertilizer, 134 pounds; Andrew Coe's superphosphate, 129 pounds; Alta Vela guano, 128 pounds; the Glasgow Company's ammoniated guano, 126 pounds; Rhodes's standard superphosphate, 124½ pounds; night soil compost, a shovelful to four hills, 118 pounds; one bushel of hen manure mixed with an equal quantity of loam, one peck of ashes, and one quart of salt, 109 pounds; no manure, 84 pounds.

The average product of these plots, including the unmanured plot, was at the rate of 46 bushels per acre, at an average cost of 75 cents per bushel, nearly. With corn at $1 50 per bushel, the statement exhibits an average profit of $34 50 per acre. The rate of increase from the nine first mentioned fertilizers, ranged from 48 per cent. to 80 per cent. The mixture of hen manure with ashes and salt was made in the field just before covering, and the plot receiving this application manifested an inferiority to the other fertilized plots from the time the corn came up until it was harvested. This result disappointed Mr. Pattee's expectations and convinced him that ashes should not be used in mixture with ammoniacal manures.

An adjoining portion of the field was dressed with sheep manure, at the rate of thirty loads per acre, night soil compost being applied in the hill; but the corn cost something more, without surpassing the average yield just mentioned.

EFFECT OF SUPERPHOSPHATE ON CORN.

C. H. Hubbard, of Vermont, reports an experiment with superphosphate on corn in 1869. The field contained two acres, being a ridge forty-six rods in length, running north and south, and the soil was a light gravelly loam. It had been subjected to a rotation of corn, wheat, oats, and clover and timothy, mown twice. The timothy was poor. In the autumn of 1868, the field was top-dressed with eight loads of compost per acre. In the spring of 1869, as appearances did not promise well for grass, it was plowed, six inches deep, for corn. Hills were marked three feet ten inches apart each way, and at the time of planting, 250 pounds per acre of Bradley's superphosphate were applied in the hill according to two methods. In ten rows of hills on the east side the superphosphate was placed directly under the seed corn, with an inch of soil between. In the remaining rows, excepting four, the superphosphate was dropped by the side of the corn, both being covered at the same time. Four rows nearly in the center of the field, and running lengthwise of it, were not fertilized with superphosphate. Two of these rows received a teaspoonful of plaster per hill; the other two rows a handful of plaster and ashes per hill, in the proportion of two parts of ashes to one of plaster. The field was hoed three times and received a uniform cultivation. The season was unfavorable, being very cold and dry, "with scarcely any real corn weather till near September 1st." In the ten rows where the superphosphate was placed under the seed, the corn came up one day earlier than in the remainder of the field, displayed a better color and more rapid growth, and ripened five days earlier than the rest of the crop; the yield being heavier and of better

quality. The rows in which the superphosphate was put by the side of the seed gave a good yield, excepting in a section which was shaded the latter half of the afternoon by a grove bordering it on the west, where the corn was comparatively small and poor, with considerable soft corn. The four rows fertilized with plaster, and with plaster and ashes, at first made equal growth with the rows dressed with superphosphate by the side of the seed, although showing a somewhat lighter color; but in July and August these four rows fell behind, exhibiting a marked difference in size and color, the corn ripening five days later than that where the superphosphate had been placed by the side of the seed, and ten days later than that where the superphosphate had been placed under the seed. The entire field yielded over 100 bushels of sound, shelled corn, which the experimenter considers a heavy crop, in view of the unfavorable season and the small amount of manure applied.

PROFIT FROM SUPERPHOSPHATE.

James W. Clement, of Warner, New Hampshire, reports an experiment with superphosphate in growing corn. The plowing of the field was completed June 6, 1868, the land having in part been broken up the preceding fall. The soil being of a cold, wet, and heavy character, and the season backward, an early variety was planted, described as "a bright yellow, twelve-rowed corn." After plowing was completed, common barn-yard manure was carted on and spread evenly and harrowed in, the quantity being at the rate of eight cords per acre. The field was then cultivated and harrowed, and was planted June 11, superphosphate being put in the hills at the rate of one hundred and fifty pounds to the acre. The crop was harvested October 1, the yield being 62 bushels of good sound corn to the acre. The receipts and expenses per acre are stated as follows: Receipts: 62 bushels of corn, at $1 50 per bushel—$93. Expenses: plowing, $4; manure, $16; spreading, $2; harrowing, first time, $2; cultivating, $3; harrowing and marking, $2; planting, $2 50; 150 pounds of superphosphate, $4 50; hoeing twice, $10 50; interest and taxes, $3—total $49 50. Profit per acre, $43 50. The fodder was estimated as paying for the harvesting of the corn. The total cost per acre of the plowing was $8; of the barn-yard manure, $48 for the eight cords. Half of this cost of plowing, and two thirds of the cost of this manure were charged to succeeding crops; but as no statement is made of the nature of the subsequent products, the question arises whether they should be made to bear this proportion of the charge. If the corn crop should be charged with the whole cost of plowing, with half the cost of the barn-yard manure, and with the value of seed, the net profit would be $31 per acre.

HOME-MADE FERTILIZERS ON CORN.

A new Hampshire farmer experimented with the following fertilizer in 1868, viz: one barrel of pure finely-ground bone mixed with a barrel of wood ashes, the heap being made on the floor of an out-building or barn, the materials being thoroughly mixed with a hoe, and three pailfuls of water added gradually during the mixing. To this compost was added half a bushel of salt. Of this mixture, a handful in each hill was applied to corn at the time of planting. The product was excellent in quality, looking like selected seed corn, and while adjoining fields of corn were nearly destroyed by worms, there was no injury done to the field in question. The compost was also used on potatoes to the same extent and in the same manner, with excellent effect.

The previous year the same farmer used on corn and potatoes a compost prepared in the following manner: Fifteen bushels of muck, which had been dug two years; one barrel of Bradley's superphosphate; one barrel of plaster; two bushels of hen manure; one bushel of salt; the whole being thoroughly worked over and mixed. A handful was applied to each hill, and the application repeated at the second hoeing. Although the fertilizer had a very good effect, resembling that of the compost of bone meal, ashes and salt, his experience led him to prefer the latter.

CORN IN DRILLS AND IN HILLS.

At the Michigan Agricultural College, in 1868, two plots of land were set apart, substantially equal in character of soil, each measuring forty-eight rods in length by two in width. The ground was plowed May 5, and manure was spread evenly and worked in by cultivator and harrow. Yellow Dent corn was planted May 21, in rows four feet apart; one of the plots being planted in hills, the other in drills. The plots were cultivated and hoed June 15, and again July 7, the plants being thinned so as to leave the same number of stalks on each plot, including an equal distribution of plants throughout the subdivisions of the plots. As nearly as possible, each of the two plots received the same amount of labor in cultivation. The stalks were cut at the bottom September 17, and stooked in good order. Three weeks afterward the corn was husked and weighed. The stalks were then again carefully stooked, and were hauled and weighed, in good condition, October 12. The corn on the portion planted in hills was rather better in quality than on that planted in drills. But the drilled portion produced 74⅙ bushels of shelled corn and three tons of stalks to the acre, against 65½ bushels of corn and 2⅔ tons of stalks per acre produced by the portion in hills.

CORN ON PRAIRIE SOIL.

The following statements exhibit the effects of careful culture on prairie soil. They are abstracts of reports of competitors for premiums offered by the Coles County Agricultural Society, Illinois:

E. R. Connelly entered ten acres of old ground, prairie soil, twelve years in meadow. He plowed early in April seven inches deep, and harrowed well, and planted in May, three and a half feet each way, covering with hoes. Plowed five times with cultivator or with shovel-plow, and hoed twice, thinning to three stalks per hill. Yield, 1,066⅔ bushels; average per acre, 106⅔ bushels. Mr. Connelly received $50 premium.

S. Dorman entered ten acres, prairie loam, barley stubble. He plowed ten to twelve inches deep with a three-horse team, and planted two and a half feet by three and a half feet. Cultivated three times, and shovel-plowed once. Yield, 1,063½ bushels; average, 106⅓ bushels per acre. Mr. Dorman received $25 premium.

CORN ON SWAMP LAND.

S. W. Bloodworth, of Griffin, Georgia, furnishes to the Department a statement in reference to a crop of corn raised by him on 1.012 acre, (or 210 feet square,) and on which he received a prize of $50 at the State fair at Macon, in November, 1869. The soil was "branch land," (creek bottom,) black mud or muck swamp, five feet deep, containing a mixture of sand, and, before it was reduced to culture, covered with a growth of brush and cane. The plot was bounded on three sides by

small running streams, or "spring branches," which were formed by excavations into ditches five feet deep, a ditch of the same depth being dug on the fourth side. By the time this preparation for drainage was completed, and the swamp cleared of its growth, the season was far advanced. The land was then broken up, and well pulverized with a Bloodworth iron plow with subsoil attachment, and the soil bedded up leaving water furrows forty-five inches apart. Three hundred bushels of fresh horse manure were then distributed in these furrows, by the side of which the plow was again run, covering the manure. In the last made furrows the corn—a gourd-seed, red cob variety—which had previously been soaked in water till in sprouting condition, was drilled in, at distances of ten inches, June 1, 1869. Midway between these drillings, and in the same furrows, Dickson's guano was dropped, a spoonful at a time; direct contact of the corn either with the guano or horse manure being thus avoided. The land being warm, the corn made its appearance in a few days. A turn-plow was then run each side of the row, throwing the earth away from the corn, which was then hoed and thinned. Ten days afterward a shovel-plow was run around the corn, followed one week after by a turn-plow throwing the earth to the corn, this process of throwing-to being repeated after ten days more. Another ten days elapsing, the earth was hauled up around the corn by hand hoes to the height of ten inches. About the first of August drought set in, and, for the purpose of irrigation, a dam was thrown across the outlet of the ditches, and the water backed upon the soil. The crop obtained was $137\frac{1}{7}$ bushels of corn, or $135\frac{1}{2}$ bushels per acre. The following exhibit is made of receipts, expenses, and profits: Expenses—ditching, $20; clearing the land, $7 50; seed, 50 cents; horse manure, $30; 150 pounds of guano, $7 50; plowing, $20; hoeing, $10 50; gathering fodder, $3; gathering and housing corn and shucks, $21; total, $120. Receipts—$137\frac{1}{7}$ bushels of corn, at $1 50 per bushel, $205 71; 1,600 pounds of fodder, at $2 per hundred, $32; four wagon loads of shucks, $20; total, $257 71; net profit, $137 71, or $136 07 per acre.

SELECTING SEED.

A farmer states that, in the spring of 1868, he planted five rows of corn with seed taken from the three inches below the top of the ear, rejecting the imperfect grains at the extreme point; then five rows with seed taken from the middle and base of the ear, rejecting the imperfect grains at the butt. The result was that the five rows planted with the seed from the middle and base of the ear ripened about two and a half weeks before the other rows, the corn of the former being better eared, and filled out to the end of the cob.

EFFECTS OF DEEP CULTIVATION.

At a farmers' convention, at Edwardsville, Illinois, John C. Burrows gave the following illustrative statement, in the course of an address on "Corn and its management:"

John L. Gill, of Columbus, Ohio, on a tract of bottom land, which for forty years previous had never been plowed to a depth exceeding six inches, and which had been cultivated annually in corn during the entire period, plowed eleven and three-quarters acres to a depth of eight inches, and subsoiled to a further depth of eight inches, and planted corn May 10 The adjoining portion of the tract was plowed to the usual depth of previous years, and planted with corn May 7. On the shallow-plowed

land the corn came up, and looked, for a few weeks, as well as on the deep-plowed land; but when the heat of July came, the corn on the shallow-plowed land came to a stand-still; the leaves curled and drooped, and gave unmistakable evidences of suffering from drought; while that on the deep-plowed land was growing vigorously, and indicated no lack of moisture. The result was that Mr. Gill obtained 120 bushels per acre, while the adjoining fields yielded less than 40 bushels per acre.

POTATOES.

AMOUNT OF SEED FOR POTATOES.

At Oak Hill, New York, in 1868, a parallelogram of land was set off, measuring twenty rods in length by eight in breadth, thus containing one acre. The soil was a slaty loam, had been mowed for eighteen years, and was broken up and planted to corn in 1867, without manure, yielding thirty-eight bushels to the acre. April 23, 1868, potatoes were planted without manure, and covered two inches deep, being in forty rows running lengthwise of the piece, five rows to the rod. In each hill of the first eight rows was planted one piece containing two eyes; in each hill of the next eight rows, two pieces containing four eyes; in each hill of the third series of eight rows, three pieces containing six eyes; in each hill of the fourth series, one small potato whole; in each hill of the fifth series, one large potato whole.

About three-fourths of the hills in the first series of rows grew two stalks to the hill; the remainder only one, the stalks being large and much branched near the ground, but not covering the ground so much as the stalks of the other rows. Series No. 2 had three to four stalks per hill, nearly as large as those of the first series. The third series had four to six stalks per hill, but they were more slender than in Nos. 1 and 2. The fourth series had four to ten very slender stalks per hill. The fifth series had five to eight stalks per hill, more stocky than those of the fourth series. The potatoes were dug October 9, 10, and 12. The following table gives the results from the several series of rows, the product being calculated per acre, in bushels and decimals of bushels of sixty pounds:

Series of rows planted.	Large potatoes. Bushels per acre.	Small potatoes. Bushels per acre.	Total yield. Bushels per acre.
First eight rows	205	7.5	212.5
Second eight rows	240	6.25	246.25
Third eight rows	190	13.75	203.75
Fourth eight rows	172.5	23.92	196.42
Fifth eight rows	185.83	15	200.83

On another piece of land two hundred hills were planted, one-half with large, and the other half with small potatoes, a whole one to each hill. One-fourth of the hills in each of the two series were thinned at the first hoeing to two stalks per hill; one-fourth to four stalks; one-fourth to six stalks, and the other fourth left without thinning. There was but little difference between the yield of the large seed and that of the small; but as between the hills thinned and those not thinned, the results were largely in favor of the former.

SUBSOILING.

Experiments on the Pennsylvania Central Experimental Farm, in 1869, exhibited a yield of 6,201 pounds of potatoes on four subsoiled plots of one-eighth of an acre each, being at the rate of 221.46 bushels per acre. Two plots not subsoiled, but otherwise treated in like manner, yielded 1,845 pounds, being at the rate of 131.79 bushels per acre. The report assumes 56 pounds to the bushel.

THINNING THE STALKS.

At the Pennsylvania Eastern Experimental Farm, six rows were laid out, three feet apart, and planted with large potatoes, whole, each row having a just apportionment of weight of seed, and containing fifty-six seed potatoes set at distances of three feet apart. In each alternate row the stalks were thinned to three in a hill, while the other rows were not thinned. In each case of comparison the row not thinned gave the larger yield. The product of the three rows not thinned was at the rate of 147.58 bushels per acre, of which 145.36 bushels were salable; of the three rows thinned, the yield was at the rate of 129.95 bushels per acre, of which 128.45 bushels were salable.

GROWING POTATOES BY MULCHING.

A New Hampshire farmer tried the following experiment on a rough, rocky, hassocky plot of land, too wet for ordinary cultivation, and unfit for scythe or plow. He spread on the land a quantity of small potatoes, and covered them with a crate of refuse straw and yard and barn rakings, giving them no further care. In due time, when the potatoes were grown, he drew them out with an iron-toothed rake. The product proved to be good, fair tubers of better quality than those grown by him in the usual way, and produced at trifling cost. He had several times grown potatoes by the process of mulching, obtaining yields superior in quantity and quality to those of seed planted in the ground.

GRASS AND HAY.

ENGLISH EXPERIMENTS WITH MINERAL MANURES.

Professor Voelcker reports to the Royal Agricultural Society of England the results of experiments with various mineral manures on clover and other grasses during the years 1867 and 1868, being in continuation of similar experiments in former years. He prefaces these statements with comments on the rapid progress which agricultural chemistry has made of late years, and on the better knowledge which has been obtained through the means thus afforded, respecting the conditions of various soils, and the adaptability of different manures to them. He remarks especially that the conditions under which ammonia, lime, or phosphates act beneficially on vegetation are far better understood than those under which nitrates or salts of potash may be advantageously applied. For this reason he has instituted numerous experiments during the last five or six years, in order to determine in what cases potash compounds or nitrate of soda may be used with advantage.

He has found by the experiments of several years that, contrary to his earlier expectations, the application of salts of potash on heavy clay land, whether to roots or to clover, has, as a rule, proved decidedly un-

remunerative, the soil evidently containing already a good supply of this element. He has not met with a single instance in which potash salts produced good effect on arable clay land, but they have been used with advantage on light sandy soils. He considers the knowledge thus gained concerning the adaptation of potash to be a valuable acquisition, as this is an expensive manure, and the agriculturist should be able to judge beforehand, with tolerable accuracy, as to the propriety and economy of its use.

The following table exhibits the manures applied and the product obtained per acre in growing clover and Italian rye grass at Escrick Park Home Farm, in 1867. Each of the plots experimented on contained one-twentieth of an acre. The soil was poor and sandy, deficient in every description of mineral matter necessary to the perfection of agricultural products, and containing, by analysis, nearly ninety-two per cent. of fine quartz sand. The rye grass and clover were sown in 1866, with a barley crop. The manures were applied April 11, 1867. The first cutting was made June 12, and the second August 24. The table shows the weight of the product in a green state:

Plots.	Manures applied.	Amount of manure per acre.		Product per acre.								
				First cutting.			Second cutting.			Total.		
		Tons.	cwt.	Tons.	cwt.	lbs.	Tons.	cwt.	lbs.	Tons.	cwt.	lbs.
1	Nitrate of soda	..	4	8	10	28	2	1	28	10	12	56
2	Sulphate of ammonia	..	4	10	10	..	2	8	4	12	18	4
3	Mineral superphosphate	..	4	5	12	56	2	11	68	8	4	12
4	Common salt	..	4	5	12	96	2	11	28	8	4	12
5	No manure	..	..	5	9	72	2	15	80	8	5	40
6	Muriate of potash	..	4	6	8	84	3	7	56	9	16	23
7	Sulphate of potash	..	4	5	7	16	2	11	28	7	18	44
8	Sulphate of lime	1	..	4	9	12	2	10	60	6	19	72
9	Mineral superphosphate Nitrate of soda	.. ..	4 4	10	17	96	2	..	..	12	17	96
10	Mineral superphosphate Muriate of potash	.. ..	4 4	9	..	..	4	15	40	13	15	40
11	No manure	..	..	6	3	4	2	15	40	8	18	44

Summary of results.—Plots 1 and 9, receiving applications of nitrate of soda, and plot 2, receiving sulphate of ammonia, though giving at the first cutting a larger yield, in which rye-grass predominated, gave at the second cutting smaller amounts than any of the other plots. As early as April 23, plots 1 and 9 could be easily distinguished from the others by their darker green color and ranker growth. The nitrate of soda, however, started a vigorous growth of very coarse and inferior rye-grass which finally choked the clover, and at the end of October hardly a single clover plant was to be seen, while the soil of these two plots was quite burned up by the exhausting effects of the nitrate of soda. At this latter date, plots 6, 7, and 10, which had received applications of potash variously compounded, manifested their superiority by their dark green hue and the healthy look of the herbage, in which clover predominated. These characteristics were especially remarkable in plot 10; here was found the largest total yield, both the clover and rye-grass being much superior in quality to the product of any of the other plots, and the soil was left in better condition for succeeding crops. The experiment shows that land deficient in mineral food is rapidly exhausted by the application of purely nitrogenous manures.

The mineral superphosphate, by itself, appears to be inefficient, the result being quite opposite to effects obtained from this fertilizer on heavier soils. The explanation is that, on account of a deficiency of

some essential element, such as potash, in the soil considered, the phosphate could not be assimilated. The case is illustrated by that of a hungry and thirsty man before whom may be placed substantial and appetizing food, yet who being denied drink is unable to assimilate the viands with which he is provided. The application of potash, non-essential to the growth of clover on many clayey soils, is necessary, as a rule, on poor, sandy soils, these being greatly deficient in this mineral ingredient.

It will be observed that on the poor sandy soil of the experiment, common salt exhibited no beneficial effect; nor is it shown that it had an injurious effect, since the smaller yield of plot 4, when compared with the unmanured plots, themselves varying somewhat in product, has no especial significance. While, however, the common salt, or chloride of sodium, did not appreciably affect the product, muriate of potash, that is, the compound of chlorine with potassium, materially increased it. Thus proof is given that soda cannot supply the place of potash in the nutrition of plants.

With regard to the gypsum applied on plot 8, at the rate of one ton per acre, Professor Voelcker remarks:

> This is a very large dose, although sulphate of lime, or gypsum, is but sparingly soluble in water, and for that reason may be used with perfect safety in much larger quantities than in this experiment, provided it is well mixed with the soil. A large dose of finely powdered gypsum, when applied as a top-dressing to young clover, appears to injure the plants and retard their growth.

Experiment at Tubney Warren, Abingdon.—An experiment similar to the foregoing was made at Tubney Warren, Abingdon, in 1867. The field had formed part of an old heath, but had been in cultivation eleven years, and had grown clover once before. The soil was naturally very light and poor, and deficient in alkalies and lime, and contained nearly ninety per cent. of fine quartz sand, but at the time of the experiment was in good agricultural condition. A mixture of different kinds of clover was sown without other grass seeds on the barley crop of 1866, after a good crop of Swedes, manured with dung and three hundred-weight of superphosphate per acre, and fed off by sheep partly kept on grain. The manures were applied early in March, 1867, and were of the same nature as those used in the preceding experiment, and in the same amounts, excepting the sulphate of lime, which in the present case was applied at the rate of four hundred-weight per acre. As little could be anticipated from a second crop of clover alone on this soil, one crop only was harvested, it being allowed to stand till the middle of July. From the report made on these operations, the following particulars are selected as containing points of difference from certain results of the experiment at Home Farm.

The clover plants were quickly and quite injuriously affected by the more soluble saline manures, namely, the common salt, the muriate of potash, and the muriate of potash and mineral superphosphate used together. However, the plots on which these dressings were applied had quite recovered toward the conclusion of the trial. The deduction from the first effects here particularized is that, since saline top-dressings check and injure the early growth of clover, especially in dry weather, it is very desirable to apply them quite early in the spring, in order that they may be thoroughly washed into the soil by the rain before an active growth begins. In correspondence with results at the Escrick Home Farm, the plot dressed with muriate of potash and mineral superphosphate gave not only the largest yield in the harvested crop, but also far the best after-growth in every respect.

In this experiment, neither muriate of potash nor sulphate of potash materially affected the product; while the mineral superphosphate applied alone gave a decided increase. These results sustain the belief that when a soil even naturally poor and sandy has been brought into a fairly productive condition, potash manures do not produce much effect, and that phosphatic manures are more likely to be beneficial.

Experiment at Menagerie Farm, Escrick.—In 1868, at Menagerie Farm, Escrick, York, the same top-dressings were applied as at the Home Farm, and to the same number of plots, of one-twentieth of an acre each. The soil closely resembled that of the Home Farm, and contained over ninety per cent. of pure fine quartz sand, little lime, and a still less proportion of available alkalies and phosphoric acid. The whole area was sown with mixed seeds, at the rate per acre of six pounds of red clover, one pound of alsike, one pound of white clover, one half bushel of Italian rye-grass, and one half bushel of Pacey's rye-grass. The manures were applied April 23; the first cutting made June 11, and the second July 23. The following is a tabulation of the results:

Plots.	Manures applied.	Amount of manure per acre.		PRODUCT PER ACRE.								
				First cutting.			Second cutting.			Total.		
		Tons.	*Cwt.*	*Tons.*	*Cwt.*	*Lbs.*	*Tons.*	*Cwt.*	*Lbs.*	*Tons.*	*Cwt.*	*Lbs.*
1	Nitrate of soda	0	4	7	0	0	0	15	0	7	15	0
2	Sulphate of ammonia	0	4	7	0	0	0	18	4	7	18	4
3	Mineral superphosphate	0	4	5	12	56	0	18	84	6	11	28
4	Common salt	0	4	5	8	84	1	0	40	6	9	12
5	No manure	..	..	4	13	24	0	19	12	5	12	36
6	Muriate of potash	0	4	5	16	28	1	6	68	7	2	96
7	Sulphate of potash	0	4	6	6	28	1	7	56	7	13	34
8	Sulphate of lime	1	0	5	11	28	1	3	44	6	14	72
9	Mineral superphosphate Nitrate of soda	0 0	4 4	6	18	4	0	17	56	7	15	60
10	Mineral superphosphate Muriate of potash	0 0	4 4	7	1	28	1	11	88	8	13	4
11	No manure	..	..	4	13	84	0	18	44	5	12	16

These results are similar to those obtained at the Home Farm in 1867; and as to the product of hay made from plot 10, it is stated to have been worth one pound sterling more per ton than that made on plot 1. It should be noted that common salt, which in 1867 showed little effect on the clover, gave an appreciable increase in 1868, namely about 15 per cent., mostly in the first cutting.

The yield of all the experimental plots was much greater in 1867 than in 1868, the difference being accounted for by the unusually dry summer of the latter year. "In a dry season, neither nitrate of soda nor sulphate of ammonia acts nearly so beneficially upon vegetation as in moderately wet weather; for it appears that these saline matters, unless much diluted by the rain-fall and thoroughly diffused in the soil, cannot exert a beneficial influence even upon those crops upon which they produce the best effect in a favorable season. Nitrate of soda, although it may be of value where an early and rapid growth of grass is demanded for dairy use, is especially apt to burn up vegetation in dry weather, and for this reason should always be used sparingly and with caution. Salt, on the other hand, is evidently beneficial to grass crops on light land in a dry season."

Experiments on permanent pasture.—Professor Voelcker reports that two years ago he caused to be commenced a series of experiments on permanent pasture. He states that for such experiments plots of not less than one-tenth of an acre each should be appropriated; and that,

as some of the fertilizers used on pasture act but slowly, while others are beneficial through a succession of years, and still others are only effective in the year of their application, it is absolutely necessary not to confine the experiments to a single season, but to continue observations through at least four years in succession.

The first of these experiments reported was made at Ashwick, Hatfield, Herts, on meadow mowed yearly during the last five seasons. It was drained in the winter of 1864–'65, and then dressed with four tons refuse gas-lime composted with pond-cleanings and road-scrapings. Considerable quantities of roots, grain and cake were consumed on it by stock at different times. The field was at one time very poor, but now grows a fair average crop for that region.

In 1867, snow fell in the latter part of March, and the latter part of April; during the most of May the weather was showery and cold. The quicklime, in five small heaps, was put on each of the plots 2 and 3, March 23, of the same year, and after being slaked by the rain was spread March 27. The other manures were sown by hand March 23, and immediately afterward there was a heavy fall of rain. The plots measured one-tenth of an acre each, and were all rolled and chain-harrowed April 1, and were mown June 24, the grass being quite dry. The following table gives the kinds and quantities of manures applied, and the weight of product per acre:

Plots.	Manures applied.	Amount of manure per acre.	Product per acre. First cutting.			Second cutting.			Total.		
			Tons	*Cwts.*	*Lbs.*	*Tons*	*Cwts.*	*Lbs.*	*Tons*	*Cwts.*	*Lbs.*
1	Quicklime .... bushels..	50	2	14	12	2	12	106	5	7	6
2	Quicklime .... bushels.. Common salt .... cwt..	50 5	2	16	78	Not known			Not known.		
3	Fine bone-dust .... cwt..	15	2	16	18	2	2	88	4	18	106
4	Mineral superphosphate ..... cwt.. Crude German potash salts.. cwt..	5 5	3	10	40	2	4	62	5	14	102
5	No manure	....	2	18	84	Not known			Not known.		
6	Common salt .... cwt..	5	3	3	104	Not known			Not known.		
7	Peruvian guano .... cwt..	5	5	3	34	2	11	48	7	14	82
8	Crude German potash salts.. cwt..	5	2	7	106	2	12	76	5	10	70
9	Mineral superphosphate ..... cwt.. Peruvian guano .... cwt..	5 5	5	6	8	2	11	73	7	17	81
10	No manure	....	2	14	52	2	4	37	4	18	89

As early as April 10, plots 1, 2, and 6, appeared much burned; also plots 4 and 8, but in a less degree. Plots 7 and 9 had a uniform dark-green appearance. Plot 3 was slightly darker in color than the unmanured plots, but rather irregular. June 9, no difference was observable between plots 1, 2, 5, and 6. Plot 3 was irregular in appearance, with patches of very heavy grass. Plot 7, very luxuriant. Plot 9, very heavy, the grass being a good deal laid.

A summary of the results at the date of the cutting of June 24 may be given in these terms, viz: Quicklime burned the grass to some extent. The salt and quicklime gave no increase up to that time; nor did the bone-dust, which had not been sufficiently acted on by the weather. The mineral superphosphate and crude potash salts gave a small increase, a little exceeding that produced by the common salt. The crude potash salts alone gave no appreciable increase. The guano and the guano and superphosphate showed a very marked superiority.

During July, which was a wet month, plot 1 appeared rather brown and burned. Plots 7 and 9 maintained their superiority. Plots 4 and 8, manured with potash salts, &c., were distinguished from the others

by an abundant growth of red and of white clover. The remainder of the plots showed little difference in appearance.

A second cutting was made October 30, except on plots 2, 5, and 6, which had been recut at an earlier date without taking account of weight. There was not a great difference between the yields of the several plots as weighed at this date. The fertilizers affecting this second crop, rank, according to the increase over the unmanured plot, as follows, commencing with the largest yield: Quicklime, guano and superphosphate, crude potash salts, guano; but the differences were hardly appreciable. The bone-dust exhibited no effect. It will be seen that, among the total yields, the guano, and the guano with superphosphate, gave much the largest products.

Experiment at Escrick Park, York, 1868.—The manures here employed were the same in nature and quantity as in the last-mentioned experiment. The soil was of the most infertile character, bearing a poor rough grass with scarcely any clover, and probably had never before been manured. The land being in this exhausted state, all the fertilizing applications told to greater or less extent on the grass crop. The manures were sown about the last of March, and the grass mowed June 25; only one crop being taken during the season. The prolonged heat and drought of the summer had an unfavorable effect on the grass, which was much burned, especially on the plots dressed with common salt, and with the potash salts. The following table exhibits results:

Plots.	Manures applied.	Amount of manure per acre.	Product per acre. *Tons.*	*Cwt.*	*Pounds.*
1	Quicklime .... bushels..	50	1	0	70
2	Quicklime .... do..	50	1	4	2
	Salt .... cwt..	5			
3	Fine bone-dust .... do..	15	1	13	34
4	Mineral superphosphate .... do..	5	1	8	14
	Crude German potash salts .... do..	5			
5	No manure	....	.....	10	70
6	Common salt .... cwt..	5	1	2	6
7	Peruvian guano .... do..	5	2	9	42
8	Crude German potash salts .... do..	5	1	11	8
9	Mineral superphosphate .... do..	5	2	16	28
	Peruvian guano .... do..	5			
10	No manure .... do..	....	.....	15	90

In this experiment the fertilizers ranked as follows in regard to results: Guano and superphosphate, guano, bone-dust, superphosphate and potash salts.

Experiment at Tyrwarnhaite Farm, 1868.—The manures were the same as applied in the preceding experiment, except that on plots 1 and 2 the quicklime was doubled in amount. On these plots the grass was considerably burned, and the yield diminished. The manures were sown March 23, and the grass cut June 27. The field of experiment had been laid down in grass fifteen years before. It had been dressed at different times with shell-sand, and was in fair productive condition, as may be perceived from the fact that the average yield of the two unmanured plots was at the rate of six tons ten hundred-weight and forty-five pounds per acre. The soil, a moderately stiff, sandy loam, contained abundance of carbonate of lime in the form of shell-sand. On plots 1 and 2 there was a diminished yield, as stated. During the season, the bone-dust exhibited no decided effect. The common salt and the potash salts diminished the yield. The superphosphate and crude potash salts mixed gave little effect, and it was judged that the superphosphate alone would

have been more beneficial. The guano, and still more the mixture of guano and superphosphate, produced a large increase in yield, amounting in the latter case to an excess of three tons two hundred-weight and twenty-one pounds, or nearly fifty per cent. over the average of the unmanured plots.

MICHIGAN COLLEGE EXPERIMENTS.

At the Michigan Agricultural College in 1868, one acre of very light sandy soil was selected from a clover field the second year from seeding and mowed once in 1867. This acre was equally divided into sixteen plots, and manures were applied to every alternate plot, as follows: the two composts of muck and ashes, and the two of muck and lime, having been carefully mixed, under shelter, in February, 1868, and shoveled over from time to time till properly incorporated. On plot 1, one load of muck and leached ashes, mixed in the proportion of five loads of muck to two loads of ashes; on plot 3, one load of muck mixed with quick-lime slaked with water, in the proportion of five loads of muck to ten bushels of lime; on plot 5, one load of muck and quicklime slaked with a saturated solution of common salt, in the proportion of five loads of muck to ten bushels of lime; on plot 7, one load of muck and wood ashes, in the proportion of five loads of muck to one load of ashes; on plot 9, one load of muck; on plot 11, one-half bushel of ashes and one-eighth bushel of gypsum; on plot 13, one-half bushel of ashes; on plot 15, one-eighth bushel of gypsum.

The clover was mowed July 2, 1868, and was well cured before weighing. A second crop was taken September 1, but was very much damaged by long exposure to rain. The following table exhibits results:

Lots.	Manures applied.	First crop.	Second crop.	Total.	Gain.	Gain per acre.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Muck and leached ashes	265	149	414	116	1,856
2	No manure	200	98	298		
3	Muck and lime slaked with water	200	78	278	47	752
4	No manure	125	39	164		
5	Muck and lime slaked with brine	128	30	158	Loss 11	Loss 176
6	No manure	134	40	174		
7	Muck and ashes	204	90	294	72	1,152
8	No manure	188	82	270		
9	Muck	224	102	326	46	736
10	No manure	211	89	300		
11	Ashes and Gypsum	204	67	271	23	368
12	No manure	154	43	197		
13	Ashes	169	49	218	15	240
14	No manure	164	46	210		
15	Gypsum	218	92	310	88	1,408
16	No manure	190	45	235		

According to this exhibit, the total products of the unmanured plots, respectively considered, ranged from one and one-sixth ton to two and one-seventh tons of hay, reckoning 2,240 pounds to the ton. It will be seen, by reference to the widely-ranging products of the unmanured plots, that the soil was, in the first place, quite unequal in productiveness. Caution is, therefore, required in drawing conclusions from these results. The statement of gain arising from each applied manure is estimated by comparison with the yield of adjoining unmanured plots. The prominent points of the exhibit are these: The muck and leached ashes,

the gypsum, and the muck and wood ashes gave the largest products; the ashes and gypsum were less effective than the gypsum alone; a loss resulted from the applied mixture of muck and lime slaked with brine.

RENOVATION OF DEPRECIATED GRASS LANDS.

"C. H. T.," of Webster, New Hampshire, reports that in the spring of 1865 he bought a field which had become almost worthless. It yielded but a scanty amount of hay, and that of very poor quality, being June-grass or white-top. A portion of the field had not been plowed for twenty-five years. He sowed two bushels of coarse salt per acre, when snow was going off, following two weeks later with about three bushels of unleached ashes per acre, and after another two weeks with two hundred pounds of plaster per acre. The product of hay was doubled in the subsequent crop. Each succeeding spring the same fertilizers have been applied in like amount and manner. Two and a half tons of hay were cut the first week in July, 1868, and another crop was cut the first week in September, yielding about three-quarters of a ton. Immediately afterward two bushels of ashes were applied, which started the grass so vigorously that at the latter part of October it looked as though no second crop had been taken during the season. The quality of the product has also improved, and instead of June-grass the field now produces timothy, red and also white clover, and some red-top. The field remained green long after surrounding fields had browned and dried up. The boundary of the top-dressing could be traced as easily as though marked by a fence.

EXPERIMENT WITH CLOVER AND ORCHARD GRASS IN SOUTH CAROLINA.

The following is a summary of an experiment in growing clover and orchard grass in the hill region in the northwestern part of South Carolina, near Blue Ridge: In February, 1867, Joseph A. David, of Greenville County, commenced operations on two acres of rather poor, sandy land, by turning under such vegetable material as was on the same with a turning plow, and subsoiled twice. He then hauled forty loads of manure from the stables, barn-yard, cow and hog-pens, besides field scrapings, and spread these manures broadcast, and turned them under. March 1, 1867, he sowed and plowed in one bushel of oats per acre, and sowed and harrowed two bushels of orchard grass and six quarts of clover per acre, and bushed lightly. The oats, clover, and grass grew finely, and in June of the same year an excellent crop of oats was harvested, paying for the manure and labor expended in preparing the land. After the oats were harvested, the clover was harvested. The clover and grass grew so luxuriantly that they choked out the weeds and crab-grass. This grass crop was not cut, but was suffered to fall and enrich the land. In the spring of 1868, the land was top-dressed with fifty pounds of plaster, one hundred pounds of Baugh's raw-bone phosphate, and fifty pounds of salt to the acre. The ground was at the time covered several inches deep with decomposing clover and grass. The new clover and grass soon made their appearance and grew finely, the clover obtaining the predominant growth. The lot was mowed in June, 1868, and yielded between fifty and sixty one-horse loads of hay per acre. In the spring of 1869, a top-dressing was applied of the same fertilizers and in the same amounts. June 9, 1869, the orchard grass stood in some places four and a half feet high, averaging three and a half feet in height. The lot was "one perfect mass of clover and grass, without

a weed," and according to estimates then made, would yield one hundred one-horse loads of hay per acre, or at least five tons per acre from the first mowing, with an excellent prospect for the fall crop.

PLASTER AND SALT ON CLOVER.

A farmer reports that, for purposes of experiment, he divided a clover-field into plots of thirty feet in width, grouping these divisions in series of three plots each. On the first plot in each series plaster was sown broadcast, two bushels per acre, at a cost of $1. On the second plot, common ground salt, two bushels per acre, at a cost of $2 50. On the third, one bushel of plaster, and one of salt, mixed, per acre, at a cost of $1 75. The order of excellence in product was as follows, beginning with the best: salt and plaster mixed; plaster; salt.

CURING HAY IN WET WEATHER.

Robert Neilson, of Halewood, Liverpool, England, in a letter to the London Times on the curing of grain and other crops harvested in wet weather, relates a trial made during the present year, the method being similar to that which he had successfully employed since 1863, in using artificial currents of cold or heated air, in curing crops harvested under unfavorable conditions. The process was as follows: The hay was stacked below a wooden cover, and upon a base bearing a wooden air-trough measuring nine inches inside, extending horizontally the whole length of the rick, and provided with slides to let on and cut off the flow of air. At the centre of this trough, and opening upward, was an aperture nine inches square, and over this aperture was placed a sack filled with straw. This sack was gradually lifted as the formation of the stack proceeded, and thus was formed a vertical chimney, which was carried to within six feet of the top of the stack. The dimensions of the completed rick were twenty-four by sixteen feet, by twenty feet in height. Currents of cold air were then driven through the stack by means of a fan connecting with the air-trough, and driven by a steam-engine of one horse-power. By these means the hay was so thoroughly cured that it was sold at the full market price, notwithstanding that at the commencement Mr. Neilson's bailiff had remonstrated against stacking hay in such poor condition, declaring his opinion that it would certainly take fire as a natural consequence. Three other stacks in different stages of condition were put up and cured in the same way; and it is stated that in the total result there was effected a saving of three-fourths of the manual labor which would have been required under ordinary procedure. Mr. Neilson indicates the applicability of horse or hand power as a substitute for the steam-engine in driving the ventilating fan.

FEEDING STOCK.

COOKED FOOD FOR SWINE.

Two experiments were made in feeding corn to five half-blood Berkshire pigs of the same litter, the first experiment being with old corn shelled and fed in three different forms, viz: fed whole; ground and made into a slop with cold water; ground and boiled and fed cold. The result of this experiment was that five bushels of whole corn made forty-seven and three-fourths pounds of pork; five bushels of corn, less miller's toll, ground and made into thick slop with cold

water, made fifty-eight and a half pounds of pork; and the same amount of meal well boiled and fed cold made eighty-three and a half pounds of pork. In each case the food was administered regularly and without waste, and other precautions were taken to secure fairness of comparison. With the whole corn kitchen slops were given, without milk; and of the boiled meal one to two quarts were thinned with cold water or house slops, for drink. The corn was estimated at $1 30 per bushel, and the pork at $14 per hundred-weight. In the case where the whole corn was fed, the price of the corn equaled the value of the pork. The same amount of corn ground, cooked, and fed cold, returned the price of the corn, and one dollar per bushel in addition.

The second experiment was with nubbins, or soft new corn, fed in two forms, viz: on the ear; and shelled, ground, and boiled.

Ten bushels of corn on the cob, fed on the ground, made twenty-nine and a half pounds of pork. Corn shelled from the same amount of ears, and then ground by horse-power and well boiled, made sixty-four pounds of pork. The pork made from cooked food was as firm as that made from uncooked. In supplement to these experiments the narrator states that, under circumstances apparently equivalent to those above reported, three bushels of meal with five bushels of potatoes, cooked, made seventy-two and a half pounds of pork, and ten bushels of corn on the ear, ground and boiled, made seventy-one pounds. From his experiments he draws the conclusion that it is more economical to allow food to become cold before it is fed out, and that in this state a larger amount will be eaten and with a better appetite.

The following is a summary of an experiment by W. F. Baggerly, of Wayne County, New York, in feeding four pure-bred Chester white pigs littered March 31, 1868. The pigs were kept in thrifty condition until October 24, when Mr. Baggerly commenced feeding to them as much shelled corn as they would consume, amounting in quantity to one bushel per day for the four animals. The result as exhibited for the week ending November 6, was an average daily gain of nine pounds on the weight of the pigs. The value of this increase is stated to be twelve cents per pound, the shelled corn thus returning a value of $1 08 per bushel. During the eleven days following, cooked Indian meal was fed, at the rate of three-fourths of a bushel per day. The result was an average gain in total weight of eleven pounds daily, making the cooked meal return a value of $1 65 per bushel. The food was then changed to cooked potatoes and meal, in the proportion of four bushels of potatoes to one of meal; the meal being stirred in after the potatoes were cooked. The result of eight days' trial was an average consumption per day of one and a quarter bushel of the mixture, and an average total gain in weight per day of nine and three-quarter pounds, each bushel of the potato and meal mixture returning a value of ninety cents. Although the experimenter draws conclusions in favor of such a mixture of potatoes and meal as a principal food, examination of the results will not justify this preference over the cooked meal, except in localities where the money value of potatoes is in very low ratio to that of corn.

EXPERIMENTS IN FEEDING SWINE.

W. Arey, of Hampden, Maine, communicates to the Department an experiment made in feeding three pigs littered in June, 1867. He commenced his daily course of feeding by giving each pig one to two gills of raw meal mixed with a sufficient quantity of milk to wet thoroughly, to which was added about a half pint of milk three times a day, with a

few potatoes boiled. The potatoes were fed until the pigs were about four months old, the particular purpose of which was the sufficient development of stomach. During the next two months three pints of raw meal with about four quarts of milk were given per day, a few boiled potatoes being occasionally added. At the close of this period of six months, December 12, 1867, the three pigs weighed, respectively, 162 pounds, 162 pounds, and 125 pounds. After this date each pig received two quarts of meal with four quarts of milk or water per day, until fattening commenced, when each received one quart of meal with one quart of drink three times a day. When killed, February 26, 1868, the pigs weighed, respectively, 249 pounds, 246 pounds, and 209 pounds; the respective gains being 87 pounds, 84 pounds, and 84 pounds, making a total gain of 255 pounds. The whole amount of corn meal fed out varied but little from 17 bushels. No valuation was put on the milk and potatoes, the former being accounted as slops, and of the latter only a small quantity was used. Mr. Baggerly has followed this course of feeding for several years with different varieties of swine, and finds that by this treatment he can safely calculate on obtaining the above average of fifteen pounds of pork for each bushel of corn. His experience demonstrates that overfeeding is a common error, and that the practice of giving swill and house slops in liberal quantities tends to produce an undue development of the stomach, and an unnatural craving for a greater amount of substantial food than can be properly utilized in growth; thus causing waste of food, and preventing the profit which might otherwise be obtained.

MAKING A HOME MARKET FOR POTATOES.

A farmer of Dubuque County, Iowa, finding that he could obtain only twenty-five cents per bushel for his potatoes at a market fifteen miles distant, concluded to use them in feeding his hogs. At first he gave them raw; but afterward boiled them and mashed them while hot; and put one bucket of bran to three of potatoes, adding water enough to make a thick slop. He gave this mixture three times a day with a little corn in the ear. The hogs fattened much faster with this feed than when they were fed with all the raw corn they would eat, with bran slop for drink.

MAKING PORK AND MANURE.

J. D. Willis, of Union Church, Mississippi, in December, 1868, put five shoats, eleven months old, in a pen having a floor three feet above the ground. This floor was covered fifteen inches deep with leaves and loam, and was so constructed that the manure made could be turned below. The floor was cleaned off once a week, and fresh material supplied, and thus all the urine saved. The shoats were kept up five weeks, each receiving during this period five bushels of corn cooked. At the close of this period they averaged one hundred and thirty and a half pounds net, and the manure amounted to one hundred and ninety bushels of good quality.

SOILING AND PASTURING.

Mr. Brown, of Mankle, Scotland, a farmer of extensive operations, made the following experiment in order to ascertain the comparative merits of soiling and pasturing cattle. In the spring he took forty-eight Aberdeenshire bullocks which had been wintered in his farm-yard, and separated them fairly into two equal lots, one of which he put to grass, while the other was soiled. The latter were fed on Swedish turnips until the clover was ready for cutting, and then the clover was given

sparingly for a week, in order to avoid danger from over-eating, after which a full supply was allowed. The animals thrived exceedingly well until the grass got hard and withered. About the last of July, the clover having ripened, vetches were substituted, which were continued until the second crop of clover was ready for cutting. Ten of the soiled lot were sold in August, and the remainder of the two lots in September. The results are thus stated: The forty-eight cattle cost in purchase and wintering, £503 2*s*. The best ten of the soiled lot sold at £17 5*s*. each; the remainder of the two lots sold at £14 5*s*. each; the soiled lot thus bringing £377, and the grazed lot £342, a difference of £35 in favor of the soiled cattle. It required one and three-quarters acre of Swedish turnips, eight acres of clover, and three acres of vetches, to furnish the food consumed by the twenty-four soiled cattle. The result of soiling exhibited decidedly the larger profit.

CONCENTRATED ROOT FOOD.

Hugh Smith, of London, England, reports an experiment in feeding sheep with kiln-dried roots, giving the expense of preparation on the basis of English labor prices, &c. He pulped eight tons of mangolds, and placed them in a kiln, spreading them four or five inches thick on the floor. In twenty-four hours the water had evaporated, leaving one ton of dry material. With eight hundred-weight of this dried food he fed five sheep for twenty weeks, putting them on one and one-half acre of very poor aftermath. Results: Amount of meat made in the given period, one hundred and sixty pounds, dressed weight; value of this meat, £5. Deduct £1 10*s*., as a liberal allowance for the grass consumed, and £3 10*s*. is left as the feeding value of the eight hundred-weight of dried substance prepared from three tons four hundred-weight of raw roots. At this time the feeding value per ton of raw material thus manipulated is £1 1*s*. 10½*d*. The cost of fuel is stated at 2*s*. 6*d*., and of labor for carting the roots to the kiln, and pulping and drying, 1*s*. per ton of raw roots. Deducting these expenses, the ton of raw roots thus exhibits a net feeding value of 18*s*. 4½*d*., against 5*s*., the value per ton of roots fed in the ordinary manner, there being, according to this calculation, an increase of more than 250 per cent. in the net feeding value of the roots. One advantage claimed for this concentrating process is that it will lead to the consumption of straw in much larger proportion, as an adjunct in feeding. Mr. Smith has taken out a patent embodying the method narrated.

COTTON-SEED MEAL FOR COWS.

Horace Colburn, of Winslow, Maine, in November, 1868, purchased five hundred pounds of cotton-seed meal and the same weight of fine feed, and commenced feeding two quarts of each material per cow, in addition to hay. In one week the cows thus fed doubled their yield of milk, the product being also improved in quality, while the animals made a decided gain in appearance. In Mr. Colburn's opinion the increased yield of milk paid for the meal and fine feed, without reckoning the increased value of the manure. The cotton-seed meal cost, in Portland, two and a half cents per pound, the fine feed three cents per pound.

FEEDING MILCH COWS WITH CORN FODDER.

A dairy farmer states that in June, 1868, he sowed an acre of corn in drills, and on the first of July commenced cutting and feeding to twenty-six cows, daily. When the September rains came he omitted the corn-fodder for some days, and the consequence was a decrease in the yield

of milk of fifty-two pounds per day, or an average decrease of two pounds per cow. The corn feeding being resumed the cows in four days regained their usual yield.

EARLY CUT HAY FOR COWS.

Dr. Nichols, of Massachusetts, cut an acre of red-top and clover, June 19, 1868, and stored the hay by itself. On the first of March following he commenced feeding this hay to ten cows, which had been kept previously on hay of the same variety cut after the middle of July. The early cut hay spent quite as well as the later cut, and the immediate increase in flow of milk arising, from the use of the former, amounted to a daily average of one quart per cow.

COTTON.

COMMERCIAL FERTILIZERS COMPARED.

The following are abstracts of reports of E. M. Pendleton, M. D., of Sparta, Georgia, on experiments made by him with various fertilizers on cotton. The first experiment covers the years 1867 and 1868, and exhibits results of application on a "mulatto soil," near Sparta. Of the fertilizers mentioned it is stated that the Peruvian guano used in "Dickson's Preparation," and in Nos. 1, 2, and 3, had been wet, and was mixed with a little plaster to aid in beating and sieving that used alone; while No. 6 was a dry superior article. Also, that "Kettlewell's A. A." was a little damp and somewhat deteriorated. The "Home superphosphate" was made by dissolving calcined bones in sulphuric acid. The trial was made on single rows, one hundred and twelve yards long, an unmanured row being left on either side of each fertilized row for purposes of comparison. The mean of these unmanured rows was taken as representing the product of the unfertilized soil in each particular case. The cotton was picked very dry on sunny afternoons, and one third by weight of the seed cotton was counted as lint, which was rated at 11 cents per pound net. The following table gives the applications made in 1867 on this "mulatto" soil, well cultivated, and receiving abundant rains; showing the cost of the applications with resulting products and profits—these profits being calculated on the excess of the fertilized soil over that of the unfertilized:

Plot.	Fertilizers.	Amount applied per acre—pounds.	Cost per acre.	Product of seed-cotton per acre—pounds.	Product of unmanured soil per acre—pounds.	Profit per acre from the application.
1	Peruvian and soluble Pacific guano	140	$6 20	1,453	553	$26 80
2	Peruvian guano, 56 pounds; dried clay, 112 pounds	168	3 30	928	452	14 16
3	Peruvian guano and dissolved bones	150	6 30	1,429	522	26 96
4	Soluble Pacific guano	150	6 00	1,472	651	24 11
5	Home superphosphate	178	6 23	1,387	600	22 63
6	Peruvian guano	150	7 36	1,590	576	26 15
7	Bones dissolved in lime and ashes	103	3 09	1,031	690	9 32
8	Kettlewell's A. A	187	7 96	1,415	569	23 06
9	Baltimore supherphosphate	178	6 23	1,275	642	16 98
10	Dickson's preparation	262	9 00	1,434	522	21 44
11	Alkaline phosphate, (Ober)	187	6 54	1,270	732	13 19
12	Calcined bones and sulph. ammonia	168	7 22	1,221	641	14 05
13	Poudrette	262	5 24	866	574	5 47
14	Sulph. ammonia, ashes, lime, and bones	337	11 25	1,209	648	9 32
15	Bone tafeu	225	6 18	881	600	4 13
16	Ashes mixed	225	4 50	759	602	1 26
17	Plaster, 168 pounds; potash, 19 pounds	187	4 20	646	578	loss 60

The following tabulation shows the per cent. profit on investment, obtained through the years 1867 and 1868, from these applications made in 1867. It should be observed in connection with these exhibits of profit that, while the pound of lint was rated at 11 cents in 1867, its value was doubled in 1868, being rated at 22 cents net:

Plot.	Fertilizers.	Per cent. profit on investment.		
		1867.	1868.	Total.
1	Peruvian and Pacific guano	432	210	642
2	Peruvian guano and dried clay	429	179	608
3	Peruvian guano and dissolved bones	428	241	669
4	Soluble Pacific guano	402	199	601
5	Home suphephosphate	363	375	738
6	Peruvian guano	355	120	475
7	Bones dissolved in lime and ashes	301		
8	Kettlewell's A. A.	289	178	467
9	Baltimore superphosphate	272	226	498
10	Dickson's preparation	271	251	522
11	Alkaline phosphate, (Ober)	201		
12	Calcined bones and sulph. ammonia	194		
13	Poudrette	104	0	104
14	Sulph. ammonia, ashes, lime, and bones	81	117	198
15	Bone tafeu	67	87	154
16	Ashes mixed	22		
17	Plaster and potash	loss 14	215	201

The following table exhibits results of fertilizers applied on a clay soil, near Sparta, in 1868; the experiment being in single rows one hundred and twelve yards long, with corresponding rows of unfertilized soil. In fertilizer 4, Peruvian guano and Pacific guano were in equal quantities; in fertilizer 6, one-fourth was Peruvian and three-fourths Pacific guano; in fertilizer 8, Peruvian and Redonda were in equal quantities. Each of the eight fertilizers named was applied at a cost of $7 50 per acre, and ten per cent. interest was allowed on the money thus invested, making the total cost $8 25. In this experiment three and a quarter pounds of cotton are estimated to produce one pound of lint worth 22 cents net:

Plot.	Fertilizer.	Amount applied per acre—pounds.	Increase in product of seed-cotton per acre—pounds.	Profit per acre from the application.	Per cent. on investment.
1	Eureka phosphate	188	651	$35 75	477
2	Gustin's ammoniated phosphate	278	586	31 35	418
3	Peruvian guano	150	553	29 25	390
4	Peruvian and Pacific guano	162	506	26 07	347
5	Pacific guano	176	488	25 50	340
6	Peruvian and Pacific guano	170	464	23 01	309
7	Nitro phosphate	188	445	21 89	292
8	Peruvian and Redonda	375	328	13 97	186

The following table exhibits results obtained in 1869, from the commercial fertilizers named, each applied at a cost of $10 per acre. Fertilizers 14 to 33 were compounded by Dr. Pendleton. As modifying the exhibit, it is stated that "Etiwan No. 1" got wet, and had to be dried and pulverized; and that the cotton-seed cake, and the phosphated cotton-seed cake, were received after the cotton came up, and were applied on each side of the row by means of a narrow scooter, thus not having

an equal chance with the other fertilizers. The season was characterized by severe drought, and Dr. Pendleton claims that the exhibited per cent. profit from the fertilizers would have been greatly increased by abundant rains.

	Fertilizers.	Profit per acre from the application.	Per cent. profit.	Loss per acre from the application.	Per cent. loss.
1	Patapsco	$9 60	96		
2	Eureka	9 40	94		
3	Zell's	9 40	94		
4	Etiwan No. 2	9 10	91		
5	Peruvian	5 60	56		
6	Rhodes's	3 90	39		
7	Etiwan No. 1	2 80	28		
8	Ammoniacal matter			$1 70	17
9	Common salt			2 00	20
10	Sulphate of ammonia			3 00	30
11	Oakley bone flour			5 70	57
12	Bat guano			7 60	76
13	Cotton-seed cake			8 30	83
14	Nitro phosphate	15 70	157		
15	Ammoniated home phosphate	15 60	156		
16	Ammoniated phosphate	14 90	149		
17	Artificial guano	13 70	137		
18	Sulphated bone and ashes	13 00	130		
19	Soluble Pacific and Peruvian guano	13 00	130		
20	Sulphated bone and ashes, ammoniated	12 80	128		
21	Ammoniated superphosphate	12 60	126		
22	Nitrated raw bone	11 40	114		
23	Sulphated horse manure	10 60	106		
24	Phospho. Peruvian, No. 1	10 10	101		
25	Ammoniated superphosphate, No. 2	9 60	96		
26	Dissolved bone phosphate	8 70	87		
27	Calcined bone superphosphate	8 20	82		
28	Calcined bones	8 20	82		
29	Phospho. Peruvian, No. 2	4 40	44		
30	Phospho. Peruvian, No. 3	4 10	41		
31	Phosphated cotton-seed cake	4 00	40		
32	Sulphated bone and ashes	3 10	31		
33	Leached ashes, sulphated			3 10	31

From these and other experiments, Dr. Pendleton concludes that phosphoric acid is the most essential element of fertilizing applications to cotton; while ammonia, though of value as a component, is subordinate in importance, and comparatively soon exhausted; and that Peruvian guano may be profitably replaced by manufactured fertilizers possessing a larger proportion of soluble phosphate.

FERTILIZERS COMPARED, AND SUBSOILING.

The following is an abstract of the report of James Davison, of Woodville, Georgia, on two experiments made in growing cotton, during 1869, showing comparison between fertilizers applied, and between subsoiling and not subsoiling. In both cases the land was prepared "as deeply and thoroughly as possible without subsoiling," which was not employed except in two subdivisions specified. Rows were opened three feet apart, and fertilizers applied in the bottom of the furrows, which were bedded up as usual, and "Dickson's select" cotton seed planted. The after cultivation, aside from necessary hoeings, was performed entirely with the Dickson sweep, in flat surface culture. It would probably have been better if the first plowing had been close and deep. Notwithstanding that rains for three successive days, about a fortnight after planting, gave the plants a vigorous start, the season was characterized by severe and long-continued drought, which, in connection with high

manuring, caused the plants to commence early in the season shedding forms and bolls in great abundance.

The first experiment was on single rows, seventy yards long, the soil "light greyish, compact, sharp, and predisposed to bake," having been cultivated in cotton with fertilization for four years in succession, and long since greatly exhausted by half a century of constant tillage. The fertilizers applied, with the cost of application, and the results obtained, are represented in the following table, in which plot (or row) 1, not manured, is taken as the basis of comparison.

In row 28 occurs an exception to the general statement of "not subsoiled," this plot having been very deeply stirred with a good subsoil plow. The advantage derived from this subsoiling is strongly exemplified by the favorable exhibit of this row as compared with several of the fertilized but not subsoiled rows:

Plots.	Fertilizers.	Amount applied per acre.	Cost of application per acre.	Product of cotton per acre.	Increase over plot 1.
		Pounds.		*Pounds.*	*Pounds.*
1	No manure	....	....	385	....
2	Peruvian guano	333	$15	735	350
3	Soluble Pacific guano	375	15	700	315
4	Wilcox, G. & Co.'s manipulated	430	15	630	245
5	Zell's ammoniated phosphate	375	15	630	245
6	Patapsco ammoniated phosphate	375	15	630	245
7	Wando ammoniated fertilizer	430	15	665	280
8	Gilham's cotton fertilizer	430	15	665	280
9	Rhodes's phosphate	460	15	630	245
10	Rhodes's ammoniated phosphate	430	15	665	280
11	Reid's phosphate	600	15	665	280
12	Reid's ammoniated phosphate	500	15	630	245
13	Phœnix guano	500	15	631	246
14	Phœnix guano, manipulated, No. 15	550	15	770	385
15	Wando ground phosphate	1,050	15	595	210
16	Wando ammoniated phosphate, No. 1	675	15	718	333
17	Brightwell & B. dissolved bones	430	15	595	210
18	Merryman's dissolved bones	430	15	770	385
19	B. &. D. dissolved bones, manipulated, No. 1	550	15	613	228
20	Phœnix guano, manipulated, No. 1	600	15	770	385
21	Dickson's compound, No. 1	550	15	595	210
22	Peruvian guano, bones, &c., No. 5	475	15	595	210
23	Peruvian guano, bones, &c., No. 7	400	15	630	245
24	Peruvian guano, bones, and plaster, No. 8	500	15	700	315
25	Peruvian guano, bones, and salt. No. 9	475	15	613	228
26	Peruvian guano, bones, and plaster, No. 12	460	15	665	280
27	25 kinds, mixed and manipulated	470	15	665	280
28	No manure, (subsoiled)	....	15	630	245

In further exemplification of the effect of subsoiling, Mr. Davison adds, that while the unmanured and not subsoiled row gave only 385 pounds of cotton per acre, against 630 pounds obtained from the unmanured but subsoiled row, an adjoining section, which is not exhibited in the table, and which was subsoiled and manured, gave 1,200 pounds of cotton per acre, being nearly double the average rate of the more highly manured area covered by the fertilized plots enumerated. By this and other conclusive experience, the experimenter is thoroughly convinced of the necessity of deep preparation of the soil, both as regards increase of productive capacity and ability to resist continued drought, and that such thorough preparation is necessary to the full development of the powers of applied fertilizers.

The second experiment was on single rows, 280 yards in length, on land of naturally light soil, which had been in culture for more than

seventy years. The field was selected on account of its impoverished condition and its uniformity of character. In this experiment the nature and quantity of fertilizers used were the same as in the preceding experiment, with the exception of the application on row 27, which was made at half rate, viz., \$7 50, and also the omission of Rhodes's phosphate from the list of fertilizers used.

The last two columns of the annexed table are added to exhibit some general comparisons of the standing of the respective fertilizers in the two experiments, A being put as the exponent of the class of best results, B as that of second best, &c. To point out more precisely an example of varied results from the same kind and amount of applied fertilizer, it will be seen that the two varieties of Phœnix guano manipulated, which, in the first experiment, appear at the head of class A, showing greater results than any of the other fertilizers, hold but a middle rank in the second experiment:

Number.	Fertilizer.	Product of cotton per acre.	Increase over plot 1.	Comparative standing of the fertilizer.	Comparative standing of the fertilizer in first experiment.
		Lbs.			
1	No manure	247	....	....	....
2	Peruvian guano	550	303	A^3	A^2
3	Soluble Pacific guano	408	161	C	B
4	Wilcox, G., & Co.'s manipulated guano,	586	339	A^1	C
5	Zell's ammoniated phosphate	343	96	C	C
6	Patapsco ammoniated phosphate	489	242	B	C
7	Wando ammoniated fertilizer	419	172	B	B
8	Gilham's cotton fertilizer	512	265	A^5	B
9	Rhodes's ammoniated phosphate	455	208	B	B
10	Reid's phosphate	564	317	A^2	B
11	Reid's ammoniated phosphate	336	89	C	C
12	Phœnix guano	498	251	A^6	C
13	Phœnix guano, manipulated, No. 15	462	215	B	A^1
14	Wando ground phosphate	391	144	C	C
15	Wando ammoniated phosphate, No. 1	486	239	B	B
16	Brightwell & B. dissolved bones	474	227	B	C
17	Merryman's dissolved bones	507	260	A^5	A^1
18	B. & B. dissolved bones, manipulated, No. 1	395	148	C	C
19	Phœnix guano, manipulated, No. 1	462	215	B	A^1
20	Dickson's compound, No. 1	560	313	A^2	C
21	Peruvian guano, bones, &c., No. 5	439	192	B	C
22	Peruvian guano, bones, &c., No. 7	516	269	A^5	C
23	Peruvian guano, bones, and plaster, No. 8	535	288	A^4	B
24	Peruvian guano, bones, and salt, No. 9	515	268	A^5	C
25	Peruvian guano, bones, and plaster, No. 12	421	174	B	B
26	Twenty-five kinds, mixed and manipulated	553	306	A^3	B
27	Phœnix, Peruvian and salt, (at \$7 50 per acre)	374	127	....	....

The composition of several of the mixed fertilizers is thus stated, the numbers of the plots referred to corresponding with those in the second table: The composition of the fertilizer applied on plot nine was 67 per cent. Rhodes's phosphate, 33 per cent. Peruvian guano; on plot eleven, 67 per cent. Reid's phospate, 33 per cent. Peruvian guano; plot thirteen, 50 per cent. Phœnix guano, and 16⅔ per cent. each of Peruvian guano, salt, and plaster; plot fifteen, 25 per cent. each of Wando phosphate, Peruvian guano, salt, and plaster; plot eighteen, 25 per cent. each of Peruvian guano, dissolved bones, salt, and plaster; plot nineteen, the same, with the exception of Phœnix guano substituted for Peruvian; plot twenty, 25 per cent. each, of Merryman's dissolved

bones, Peruvian guano, salt, and plaster; plot twenty-one, 33 per cent. each of Peruvian guano and bone, and 17 per cent. each of salt and plaster; plot twenty-two, 38 per cent. each of Peruvian guano and bone, and 12 per cent. each of salt and plaster; plot twenty-three, 33⅓ per cent. each of Peruvian guano, bone and plaster; plot twenty-four, 33⅓ per cent. each of Peruvian guano, bone, and salt; plot twenty-five, 60 per cent. of bone, and 20 per cent. each of Peruvian guano and plaster; plot twenty-seven, 50 per cent. Phœnix guano, and 25 per cent. each of Peruvian guano and salt.

A REMARKABLE PRODUCT.

The following is an abstract of the statement of Colonel B. G. Lockett, of Albany, Georgia, on the method pursued by him in growing cotton, in 1869, on six and eighty-eight thousandths acres of strong limestone soil, chocolate-colored, cultivated in vegetables for twenty-five years previous:

The land was broken about six inches deep, in the latter part of January, with the Watt & Knight "A B" plow, the large mould board attached. The land remained in this condition till planting time, when rows were laid off five feet apart with an ordinary scooter plow, which was followed in each furrow by a double-wing shovel plow, sixteen inches long by eleven inches wide, drawn by two mules. In this furrow were put about one hundred and fifty bushels of well-rotted horse manure, and three hundred pounds of John Merryman & Co.'s ammoniated dissolved bones, per acre, which was then covered with the Watt & Knight "A B" plow, small mould-board attached, followed in the same furrow by a sub-soil plow, breaking to the depth of fifteen inches. The seed was then planted, the "Hunt variety," April 24, putting in one bushel per acre. As soon as the cotton was large enough, it was plowed with a sweep, cutting twenty-four inches wide and half an inch deep, and was at once chopped to a stand, using the No. 2 Schoval hoe, leaving one and two, and sometimes three stalks, at the width of the hoe, and, as nearly as could be estimated, ten thousand stalks to the acre. The cotton received two hoeings, and was plowed seven times with the twenty-four-inch sweep, cutting not more than half an inch deep. The amount of seed-cotton gathered was 27,206 pounds, certified weight; one-third of this weight, on being ginned and packed, turned out 2,884 pounds of lint, exhibiting an average of 1,420⅝ pounds of lint cotton per acre. On this crop a premium was given at the Georgia State Fair.

Colonel Lockett remarks that his experience is that the number of stalks which should be left on the acre depends greatly on the variety planted. The large, long-limbed variety will not give a great yield when eight to ten thousand stalks are left on the acre; but the short-limbed, prolific cotton, will do better with this than with a less number.

FERTILIZED *vs.* UNFERTILIZED COTTON LAND.

Dr. Alford, of Louisiana, on two and one-quarter acres of poor pine land, applied superphosphate at the rate of 350 pounds per acre, planting cotton and cultivating in his usual manner. The result was that from this fertilized land he gathered 3,000 pounds of seed-cotton, or 1,333 pounds per acre, while similar land adjoining, not manured, produced only 400 pounds per acre. Thus the application of the superphosphate, at a cost of $14 per acre, caused an increase of 933 pounds of seed-cotton per acre, estimated to be equivalent to 300 pounds of lint, which sold at $60.

James Morris, a neighbor of Dr. Alford, used superphosphate for cotton, leaving an unmanured portion in the center of the field, and obtained similar results.

EXPERIMENT IN PLANTING COTTON.

A planter, near Columbus, Mississippi, experimenting on one acre, set his cotton plants three and a half feet apart, each way, thinning to two stalks in the hill, and cultivating in the same manner as with corn. The yield was more than double that grown in the old way, and in respect to the maturing of the bolls, advantage was found in the readier access of the sun.

MISCELLANEOUS.

EXPERIMENTS AT ROTHAMPSTED, ENGLAND.

The following is an abstract of certain reported results for 1868: As to manures for turnips, phosphoric acid, in the shape of superphosphate of lime, is found to be very efficient; but when superphosphate is used alone the immediately available nitrogen of the soil is rapidly exhausted. Very large crops of turnips can be obtained only through the agency of abundant carbonaceous and nitrogenous matter in addition to mineral elements; and when these are available in the soil or are supplied by farm-yard manure, guano, ammoniacal salts, &c., rapidity of growth and amount of yield are greatly increased by the application of superphosphate of lime near the seed.

EXPERIMENTS WITH COMMERCIAL FERTILIZERS.

Dr. J. R. Nichols, of Massachusetts, gives a brief statement of results obtained by him from using various fertilizers in the renovation of an impoverished farm purchased by him in 1863; only a small quantity of barn-yard and stable manure being used during the five years covered by the statement. The farm is quite varied in the character of its soil, and includes both upland and lowland, a fine peat bog lying between the hills. A portion is silicious; another portion loamy, with a clay subsoil; and still another part is rich with organic débris, having been covered, until within a few years, with dense forest. Perhaps no tract of land in the country presents a greater variety of soils, or exposures, or affords the gradations from wet to dry so desirable for fair experiment. About twenty acres have been under tillage. The fertilizers used included bones, ashes, lime, salt, the nitrates of potash and soda, sulphate of ammonia, carbonate of ammonia, plaster, potashes, fish-pomace, shorts, muck, horn-shavings, and refuse of lobster factories. There has been a steady increase in the yield each year notwithstanding unfavorable seasons, and Dr. Nichols claims that the results prove that exhausted soils can be restored and sustained in good tilth by concentrated chemical agents at a considerably less expense than by the use of excrementitious manures, at present market prices, in the more densely populated regions of the country. He gives the following history of the treatment of one measured acre of hill land, which, at the date of purchase, was dry and exhausted from repeated croppings: In the autumn of 1863 the lot was plowed, and in the spring of 1864 was dressed with 500 pounds of pure, fine bone, sown broadcast. Corn was then planted, a handful of home-made superphosphate mixed with ground

nitrate of soda being placed in each hill. The crop obtained was 157 bushels of corn in the ear. After removing the corn the land was plowed and dressed with 500 pounds of a compost of bone-dust, ashes, and refuse saltpeter, and sown with winter rye. The yield was 31 bushels of nice plump grain. The season of 1866 was very dry, and the tender grass roots were greatly injured. The crop of hay was 2,300 pounds. In the spring of 1867 the land was top-dressed with 500 pounds of compost of bone gelatine and muck; the crop of hay obtained weighed 4,300 pounds, not including a heavy aftermath, which was not weighed. In 1868 the acre yielded two and a half tons of hay, remaining in good condition. The fertilizers, supplied during the five years, cost a little less than thirty dollars.

CHEMICAL AND BARN-YARD MANURES COMPARED.

M. Ville gives results obtained by him in one hundred and sixty cases of beet culture in 1868. The averages of these results showed the product of chemical manure to be four tons of beets per acre in excess of the product of barn-yard manure, with substantially the same cost of application.

An English agriculturist gives the results of experiments made for fourteen years continuously in raising wheat and barley, with the use of farm-yard manure and with various chemical manures, the advantage in every case resting with the chemical fertilizers. The cost of the barn-yard manure is estimated at 8*s*. to 10*s*. per ton; of muriate of ammonia, 16*s*. per hundred-weight; of sulphate of ammonia, 14½*s*. per hundred-weight; sulphate of potash, 15*s*. per hundred-weight; sulphate of soda, 4*s*. per hundred-weight; sulphate of magnesia, 6*s*. per hundred-weight; superphosphate of lime, 5½*s*. per hundred-weight.

EFFECTS OF GUANO.

David Mosely, of Westfield, Massachusetts, manured seven acres with fifteen ox-cart loads of good stable manure, and on five acres of the seven sowed one hundred and fifty pounds of guano per acre. The yield of these five acres exceeded that of the other two acres at the rate of twenty-three bushels of corn per acre. Three hundred pounds of guano produced more potatoes than twenty ox-cart loads of manure.

MUCK ON SANDY LOAM.

A farmer of Washington County, New York, in 1868 plowed up a piece of sandy loam, naturally cold and wet, and of a very poor quality, and planted it with potatoes, covering them with rotted horse manure, putting on this a little earth in order to prevent drying. Six rows through the center of the piece were left without manure, and six were top-dressed with muck taken from the sides of a ditch dug in 1867. The rows dressed with the muck grew ranker and darker-colored than those dressed with the horse manure, but no difference in yield was found between the two portions, each giving at the rate of sixty bushels per acre. The rows without manure of any description yielded at the rate of twenty bushels per acre.

EXPERIMENT WITH STRAWBERRIES.

A strawberry-grower states that in a half hogshead of rain water he put one-quarter of a pound of ammonia, and one-quarter of a pound of

common niter, and with the solution sprinkled the strawberry plants when blossoming. The application was made at evening, twice a week, and continued until the fruit was nearly of full size. The result was that the vines thus fertilized gave double the amount of fruit obtained from adjoining vines which did not receive the application.

CHANGE OF SEED.

A farmer in New Hampshire, who has been experimenting in changing seed potatoes, states that he planted in thirty-four hills seventeen potatoes weighing four and three-fourths pounds, which were raised two hundred miles from his farm; and in the same number of hills he planted the same number and weight of the same variety, which had been planted on his farm for twelve years. The rows were planted side by side, and received the same treatment. The yield was as follows:

	New seed.		Old seed.	
	Number.	Pounds.	Number.	Pounds.
Large marketable potatoes	428	102	350	82
Small potatoes	630	32	780	51
Total	1,058	134	1,130	133

The farmer concludes that, while a change of seed may not increase the aggregate weight of product, it will pay in the increased value of the crop for market.

THICK AND THIN SEEDING OF GRAIN.

An English agriculturist, T. L. M. Cartwright, reports the following experiment as to the product of grain from thick, thin, and very thin sowing. Three kinds of wheat were experimented with, the two pecks and the four pecks being sown in drills twelve inches apart, and the eight pecks in drills six inches apart:

Size of plot.			Quantity of seed per acre.	Product of plot.	
TALAVERA WHEAT.					
Acres.	*Roods.*	*Perches.*	*Pecks.*	*Bushels.*	*Pecks.*
0	2	0	2	13	1
0	2	0	4	14	3
0	2	0	8	14	1½
HUNTER WHITE WHEAT.					
0	2	1	2	11	2
0	2	1	4	13	0½
0	2	1	8	12	1
FENTON WHEAT.					
0	2	2	2	15	2¾
0	2	2	4	16	0⅓
0	2	2	8	14	3¾

VARIATION IN SEEDING.

Mr. Harvey, the superintendent of the East Pennsylvania Experimental Farm, reports that thus far experiments show a great difference

in the amounts of seed required by different varieties of wheat sown at the same time, the Tappahannock requiring much more than some kinds of Mediterranean, for the reason that the former will not stool or thicken up to so great an extent. Again, much depends on the time of sowing. Very early sown wheat has a good opportunity to tiller in the fall, and a small amount of seed suffices; while if sown late it does not tiller well in the fall, and, being thin on the ground and unsheltered, the winter injures it, and a poor crop follows. Thin seeding cannot profitably be practiced in Pennsylvania to the extent that it is followed in England, where the winters are mild and the plants tiller and make roots during a time when ours cannot do so.

VITALITY OF SEEDS.

A recent experiment exemplifies the vitality of seeds exposed to cold, under the condition of exclusion from free air. Professor Wartman, of Geneva, Switzerland, selected nine varieties of seeds, some of them tropical, placed them in hermetically sealed tubes, and subjected them to the severest cold. Some of these tubes remained fifteen days in a mixture of snow and salt; others were placed in a freezing bath of sulphuric acid. On the 5th of April the seeds were all sown in pots and placed in the open air. They all germinated, and those which had undergone the severest test of cold produced vigorous plants.

PREVENTION OF RUST IN WHEAT.

A distinguished German agriculturist states that about six hours before sowing his wheat he prepared a steep of three measures of powdered quicklime and ten measures of cattle urine. Two quarts of this he poured on a peck of wheat, stirring it with a spade until every kernel was covered and white with the preparation. By this method his wheat escaped rust entirely, although in neighboring fields a great part of the crop was affected by the disease. He has followed this practice for many years with decided success.

UNCERTAINTIES ATTENDING SINGLE EXPERIMENTS.

The great caution necessary in forming opinions from the results of single experiments, especially as concerning the application of manures, is instanced by an experiment made at the Michigan Agricultural College in 1868, on a field of about two hundred and twelve square rods, subdivided into twenty-eight plots. The entire area was nearly level, and the soil a light sandy loam, of uniform character. No manure had been applied since 1864. May 8, 1868, the plow was run to the depth of five inches through the sod, which was turned under with a flat furrow-slice. May 19, the surface was prepared by cultivating and harrowing, and on the next day Yellow Dent corn was planted in hills four feet apart each way. The field was cultivated and hoed June 16, when the plants were thinned to the same number in each hill, and again cultivated and harrowed about the middle of July. The corn made slow growth during the early part of the season, and the severe drought affected the crop. The products of these plots thus uniformly treated ranged from 27⅓ bushels of shelled corn and one ton of stalks per acre, to 63⅞ bushels of shelled corn and two tons of stalks per acre; the average yield being 48⅙ bushels of corn and 1⅔ tons of stalks per acre.

A fairer comparison is likely to be obtained when the ground is di-

vided into strips extending the whole length of the field, the actual inequalities of the soil being thus in a measure averaged throughout the several divisions. For example: The main portion of the described field consisted of a quadrangle containing twenty-four plots, each measuring four rods by two rods. Let these be considered as consolidated into six strips, extending the entire length of the quadrangle, and measuring each sixteen rods by two rods. The products of shelled corn exhibited on these six divisions will then stand as follows, giving rates per acre: $41\frac{3}{4}$ bushels, $47\frac{1}{4}$ bushels, $53\frac{3}{4}$ bushels, $54\frac{1}{2}$ bushels, $52\frac{1}{3}$ bushels, $51\frac{3}{5}$ bushels. Average, $50\frac{1}{5}$ bushels.

CURING CORN FODDER.

A farmer in Ontario County, New York, on a field duly prepared, sowed oats broadcast, in the usual amount, and afterward drilled in corn in the proportion of three bushels of corn to one of oats. The two products grew very evenly. For immediate use installments were cut for general harvesting, and when the oats were ripe the crop was cut like grass. The dry oat-straw absorbed the moisture of the cornstalks, and the whole was easily cured. Horses and cattle devoured it speedily. So satisfactory did this method prove that the experimenter made it a rule of practice.

EXPERIMENT IN DEEP PLOWING.

In 1868 an experiment was made, by the director of the experimental farm of Eastern Russia, in growing the sugar beet on two plots of ground, each containing six hectares, or about $14\frac{5}{8}$ acres. One of the lots, designated A, was plowed to the depth of nine inches; the other, designated B, was plowed 9 inches deep, then, in the same furrow, five inches deeper, and then stirred, without turning over, to a further depth of seven inches, making in all a depth of twenty-one inches. In other respects the lots were treated alike, both receiving the same manures. The result was that A produced eighty-two measures of roots, and B one hundred and ninety measures. The proportion of saccharine matter in the product of A was 11.15 per cent.; in that of B 15.22 per cent. Consequently the crop of B contained more than three times the amount of sugar that was found in the product of A.

TEMPERATURE OF COW STABLES.

In Germany two cows, the united weight of which was 1,722 pounds, were placed in a stable capable of being heated, and were fed on hay. The temperature of the stable was changed at intervals of ten days, the changes ranging from 41 degrees of Fahrenheit (nine degrees above freezing point) to 65.75 degrees of Fahrenheit. During the ten days at the lower temperature the hair became rough and without gloss; the skin was drawn close, and occasional shiverings were observable, and there was a loss of 22 pounds in the total weight of the two cows. At 54.5 to 59 degrees, the hair became smooth and the hide attained its former luster, softness, and looseness. The ten days at 56.5 degrees showed a total increase of 35 pounds, and the ten days at 59 degrees a total loss of 6 pounds; the ten days at 65.75 degrees exhibited a loss of 33 pounds. The effects of unfavorable temperatures were also visible in diminished appetite and in variations of the milk product.

EXPERIMENT WITH BITUMINOUS COAL ASHES.

An experimenter filled three flower pots with pure bituminous coal ashes, in the fall, and in the first sowed wheat, in the second oats, and in the third strawberry seed. The seeds germinated during the winter, and in March the plants made a fine appearance. The wheat and oats ripened perfectly, the grain being large, clear, well filled, and heavy; the wheat straw attaining a height of over fifty-four inches; the oat straw a height of forty-three inches. The strawberry plants had an excellent growth, and were transplanted in October. In the open ground they subsequently were the greenest and strongest of all the seedlings.

EXPERIMENT IN DESTROYING GRUBS.

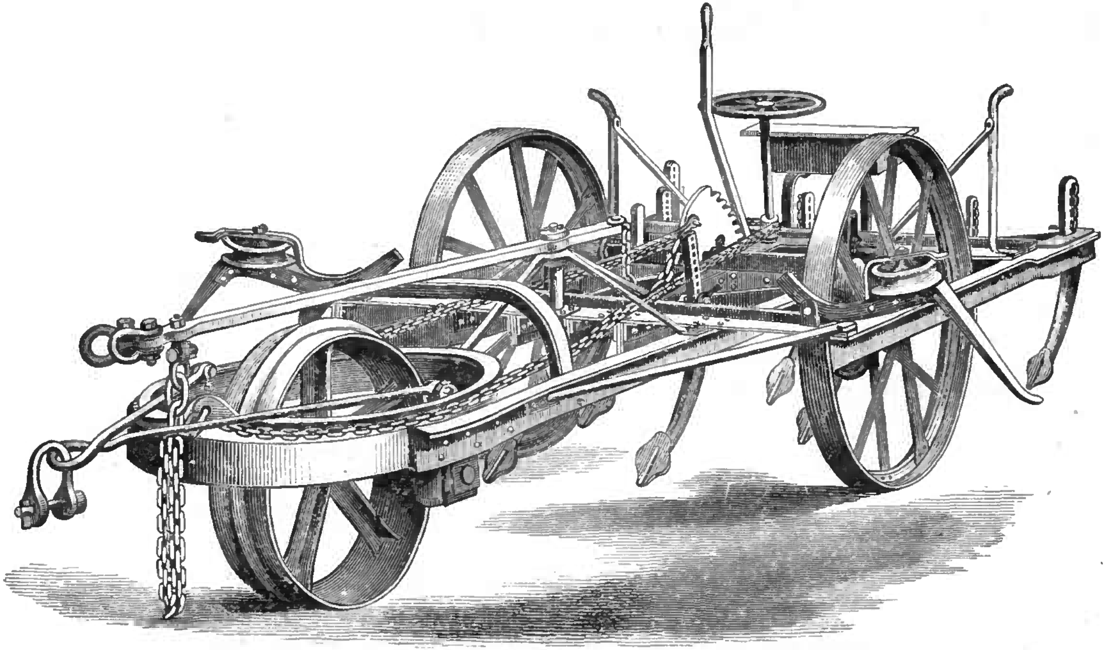
Mr. Skinner, of the Herkimer County (New York) Farmers' Club, in the spring of 1868 plowed up three and three-fourths acres of old sod greatly infested with grubs. On this field, soon after the plowing, he sowed two barrels of coarse salt which was mostly dissolved by a rain which fell a day or two afterward. The ground was then thoroughly harrowed and planted with corn, about half a pint of leached ashes being placed in each hill. The yield of corn was very large, and not a hill was injured by worms.

DESTROYING THE TOBACCO WORM.

A tobacco planter states that at the time of setting out his plants he set among them a few plants of the Jamestown weed, (*Datura stramonium*,) of the blossoms of which the tobacco worm is very fond. These weeds blossomed just in season for the advent of the worm. He then mixed an ounce of "fly-stone," or cobalt, with water, making the compound very sweet with honey, and put it in a bottle, in the cork of which a goose quill was inserted. Every evening, just after sunset, he dropped the mixture into the blossoms of the Jamestown weed, about three drops to each. The worms were destroyed in large numbers, and this success induced repetition of the process on neighboring plantations with similar results. As a matter of convenience, the blossoms into which the poison was dropped were pulled off on the morning after the application, in order to prevent the poison from destroying the weed itself.

RECENT PROGRESS IN STEAM CULTURE.

The conviction forces itself upon all progressive minds, that this country will ultimately become the great theater of steam culture. The degree of success already attained on British soil is only an earnest of greater accomplishments, and a gateway for a more successful march of mechanical invention, in which the mechanics of this country will participate, and it is believed (even by English artisans) secure the highest triumphs. It has been, and is, one of the prominent aims of the Department of Agriculture to aid in the solution of the practical question of steam culture for the American continent. Already many inventions have been patented, and one, that of E. C. Bellinger, of South Carolina,



STEAM CULTIVATOR.

PLATE XXV.

dated November 19, 1833, involved the principle improved upon by John Fowler, in England, twenty-one years subsequently, which has established itself as the first real success in the practice of steam culture.

During the past year, as will be seen by examination of a paper upon the agricultural patents of 1869, in this volume, several inventions have been added to our former list, showing that the American mechanical mind is pregnant with this idea. The issue of patents in this class may yet rival in prolificacy the inventions in improvement of the American reaper. It is useless now to speculate upon the precise character and mode of operation which the successful steam plow of the future shall assume; it is only important, by showing precisely what has been accomplished, to aid in the development of a machine which shall be speedier in movement, more economical in execution, and better adapted to the peculiarities of our soil and surface, and to the peculiar wants of our agriculture, than any as yet in operation.

The greatest measure of success in this country with the Fowler plow (five of which have been introduced) has been attained in Louisiana, upon the plantation of Mr. E. Lawrence, a sugar planter, of Plaquemines Parish. Three sets of double-engine apparatus have been worked there with efficiency and economy, and with little difficulty in adapting labor to the new mode of cultivation. In England a similar experience is reported. Mr. R. W. Eddison, of the firm of John Fowler & Co., writes to Mr. Lawrence that, "as a rule, the best farm laborers make the best steam plowmen and engine drivers, and are more satisfactory than mechanics in the field." The following statement of the experience of Mr. Lawrence presents a gratifying view of the practical results of his experiments:

In the fall of 1867, I imported a complete set of four-horse power, double engine, steam plowing tackle from Messrs. John Fowler & Co., of Leeds, England. Owing to the very rainy and bad weather in the fall and winter of 1867, our plowing operations were very limited. Our work, however, proved very satisfactory, and the facility and ease with which my laborers were enabled to handle the tackle, and the anxiety to have more powerful engines for our heavy, stiff clay soils, determined me to order from Messrs. Fowler & Co. a set of their twenty-horse power steam plowing tackle, which I have found to be all that was required for our heaviest work. Since then both sets have been in constant use in plowing the lands. When employed in breaking up, with the mold-board plow, they run to the depth of fifteen to twenty inches; and when cultivating or sub-soiling between the planted and ratoon cane rows, to the depth of twenty to twenty-four inches.

On the first forty acres of steam plowed lands, which were broken up in the spring of 1868, and planted in corn and peas and sugar cane in the fall of the same year, there was a yield of over 100,000 pounds dry sugar, being over 2,500 pounds, or two and a half hogsheads, of sugar to the acre. On other steam plowed lands, planted the following spring in cane, the result has been nearly as satisfactory, and this, too, during a season more unpropitious for the yield of sugar than any I have known for the last twenty-five years. Many of my fields, where the stand of cane was equally as good, but cultivated only with horse or mule power, and receiving much more labor and attention than the steam plowed lands, did not produce more than 1,500 pounds, or one and a half hogshead, to the acre. Therefore, my experience, as you can readily perceive, fully justifies me in stating that the yield of cane upon the steam plowed and steam cultivated lands, and with less than half the labor, will be fifty per cent. greater than can possibly be obtained by any other mode of cultivation. The advantages which will be derived from the application of steam to the cultivation of the soil in our rich and inexhaustible lands in the valleys of the Mississippi, and the vast prairies of the West, so admirably adapted to steam cultivation, are not now within the reach of the human mind to calculate.

The prejudices against steam cultivating machinery may yet, for a time, retard its general use on this continent; but the scarcity of labor and the rapidly increasing demand for it, now so sensibly felt in every section of our country, can be supplied only by the introduction into general use of the steam plow. It will supersede the necessity of the introduction of Chinese labor. We shall then be able to supply the world with cotton, bread, and meat. There is no country so admirably adapted to steam cultivation as ours; and I believe the day is not far distant when the smoke of the steam plow will

ever be in sight of the millions of freemen who will then cultivate and inhabit our vast agricultural continent.

The double engine plow imported by Colonel Patterson, and first employed in New Jersey, is now in successful operation on the plantation of General Wade Hampton, in Washington County, Mississippi, employed in the plowing and cultivation of cotton lands. The set introduced into the West, but never, so far as we can learn, properly tested there, has been purchased by Wade Hampton for use in Mississippi. Five sets are, therefore, in use in this country, and another has been ordered for a sugar planter in Louisiana. One of the Lawrence sets has recently been purchased by Chaffraix & Agar, sugar planters in Plaquemines Parish, 15 miles below New Orleans.

DIFFERENT KINDS OF TACKLE.

From the results of the numerous experiments made by the late John Fowler, in connection with steam tillage, and from careful observations of the practical working of the machinery during a series of years, the proprietors of the Fowler steam-plow works, Leeds, England, came to the conclusion, now generally adopted, that no single class of apparatus is capable of meeting in the most efficient and economical manner the varied requirements of surface and modes of culture.

To adapt the machinery to the various requirements, the company manufacture five classes of tackle, which embrace all the systems now in use. Three of these are varieties of the direct system; one of the roundabout; and the other a combination of the two systems.

No. 1 is worked by a traction engine, with clip-drum attached, moving along the headland in connection with the patent anchor. Its plan of working may be understood by reference to the frontispiece in the Commissioner's report for 1867, and to Fig. 1 in this article. On the left headland is the engine, and directly opposite to it, on the other side of the field, instead of the second engine, is the anchor. This anchor is a low heavy truck with six thin disk wheels which cut into the soil and resist the side strain. It carries a windlass, around which the steel wire rope passes. It is made to move along the headland by the motion of the sheave or pulley, which is turned by the rope. The sheave is connected by gear to a drum which winds up a rope stretched along the headland, thus keeping the anchor opposite its work. The frame is made entirely of wrought iron, and is provided with a steerage, which enables it to be worked along a crooked headland. It may be managed by a boy, who can also attend to shifting the rope porters. The position of the engine and anchor when at work can be seen at *a* and *b*, Fig. 1. This is similar in principle to the patent of E. C. Bellinger, of South Carolina.

The engine is so constructed that any part requiring to be removed can be taken off while steam is up, the fastenings being quite independent of the boiler. The windlass consists of a single sheave, five feet in diameter, around which the rope takes a half turn; the groove into which the rope passes is formed of a double series of small clips, which, on the least pressure, clasp and hold the rope until it takes the straight line on the other side, when they freely open and liberate it. The power is conveyed to the windlass by an upright shaft from the crank shaft. The road wheels are of wrought iron, twenty inches wide. Clip-drum engines for this system are made of eight, ten and fourteen horse-power; and may also be used for threshing and other purposes where steam power can be applied.

The cost of this machinery, at the works, including engine, anchor, rope, and porters, is from £730 to £815. This does not include cost of

the plow, which varies according to the number of furrows it cuts. The two-furrow plow costs £45; three-furrow, £65; four-furrow, £80; six-furrows, £95; and eight-furrows, £120.

No. 2 is the double engine tackle, having two engines working independently along the opposite headlands, each alternately drawing the implement toward itself; the engine not in work paying out the rope while moving into position for the return bout. The implements are figured and described in the report of the Commissioner of Agriculture for 1867. This tackle is the most suitable for all kinds of work, being set and taken up with more facility than that of any other system; but as the first cost is heavy, the expenditure of capital required prevents its general adoption, except for large estates or for letting out on hire. Where ample employment can be obtained for it, this apparatus is the cheapest in the long run and will do work for less money per acre than any other. To this class belong all the machines and tackle brought to the United States.

No. 3 is worked by an engine fitted with two winding drums, so that it can be used in three different ways—like the clip-drum engine, it will work with a traveling anchorage; it can also be used as a stationary engine, with ropes led round the pulleys, much after what is called the roundabout plan; and it can also be used in conjunction with a duplicate engine to drive two implements at once. The roundabout mode enables the machine to deal effectually with hilly land, badly-shaped inclosures, or wet soil, an advantage that will at once be apparent. The plan of working this machine is shown in Figure 1. This figure shows the tackle working both ways, the black lines indicating its position when working direct, and the dotted lines when working with the engine stationary. The cost of this tackle at the works in England is as follows:

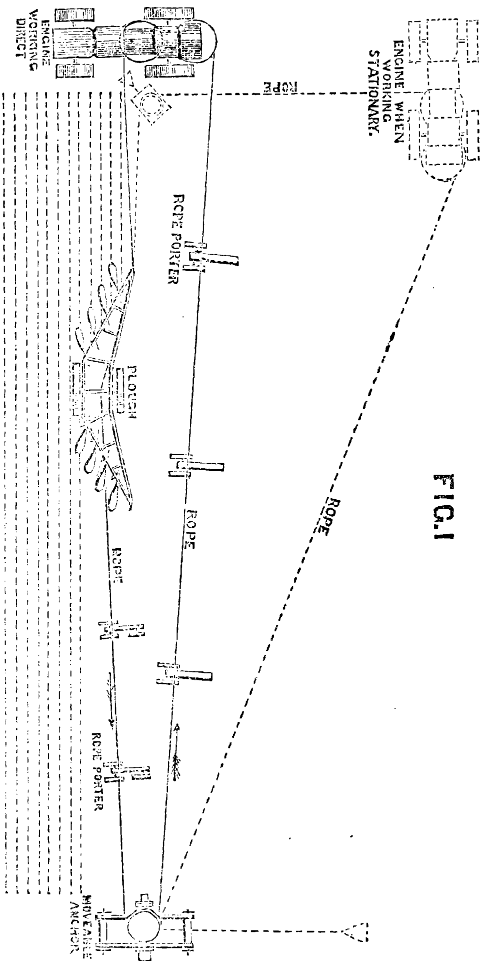


FIG. I

Twelve-horse power, single cylinder traction engine	£620
Self-moving anchor, with tools, &c	55
One thousand two hundred yards best hard steel rope	118
Ten large and ten small rope porters	25
Extra parts and rope required when working stationary	50
Total	868

No. 4 may be called the "double-double" tackle. It is worked by two engines fitted with double winding drums. Two implements are worked at the same time in opposite directions, passing each other or turning in the center of the field as may be deemed desirable, as shown in Fig. 2.

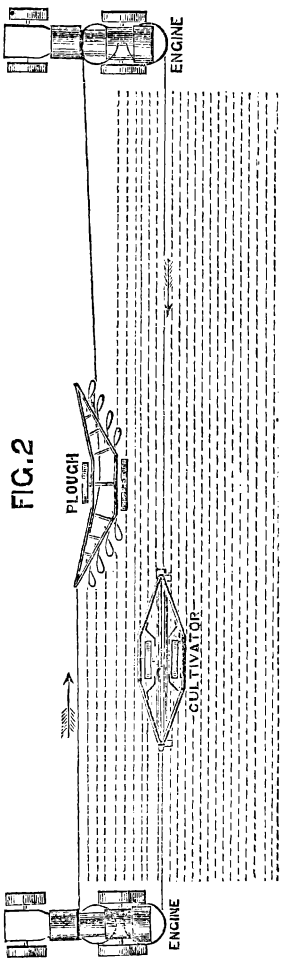


FIG. 2

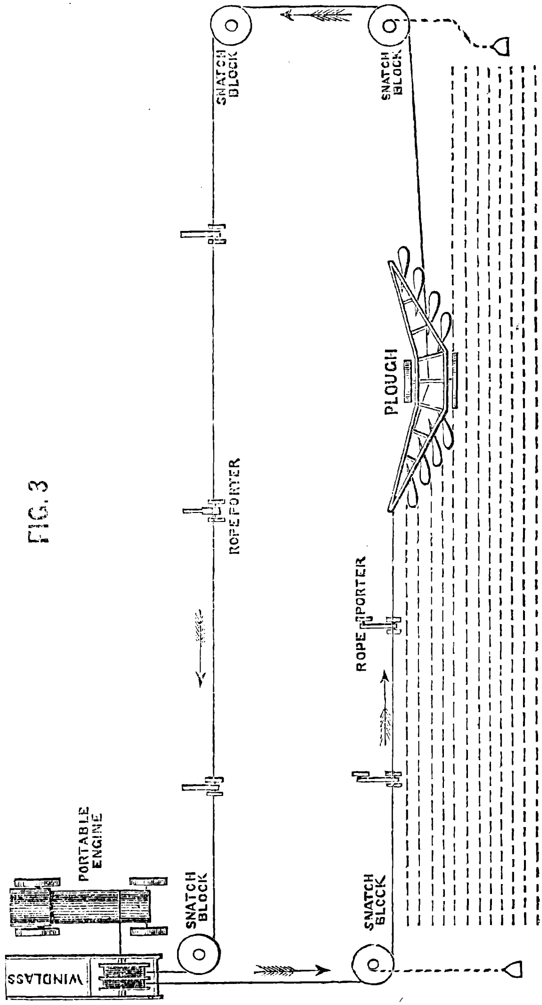
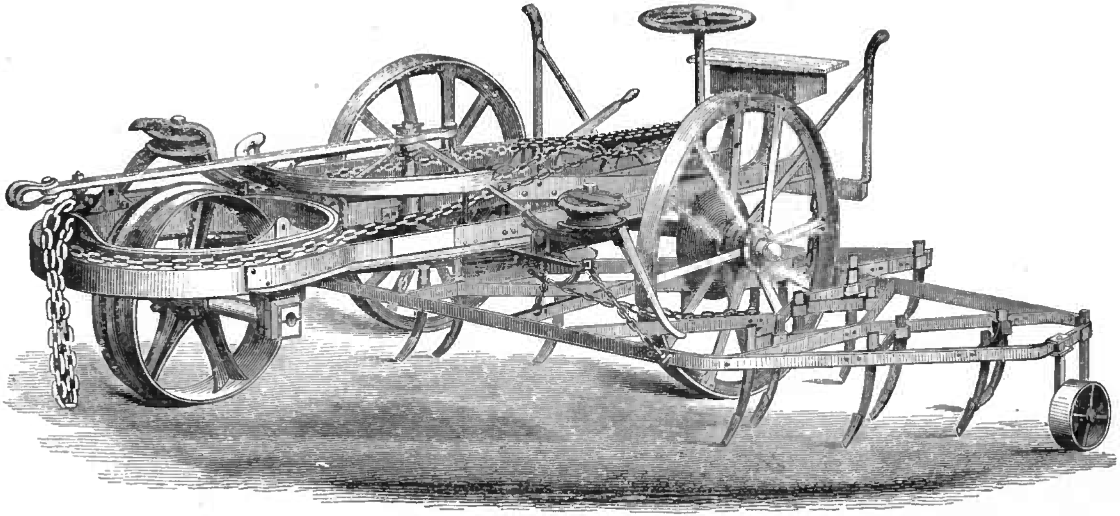


FIG. 3

By this method the power of both engines is continually employed, and an immense amount of work can be done; but it is only suitable for very favorable and exceptional circumstances. A set of this class with twelve-horse-power engines, and exclusive of implements, costs, at the works, at Leeds, £1,428. This is nothing more than class No. 2, with an additional drum on each engine, operating two implements instead of one.

No. 5 is a cheap tackle made to be worked by a portable engine. It consists of detached winding windlass, snatch blocks, claw anchors, &c., suitable for those whose requirements do not warrant the purchase of the larger and more readily applied systems. The plan of working is fully shown in Fig. 3.



STEAM HARROW.

PLATE XXVI.

The chief advantage of this roundabout system is its comparatively small cost—the price of the tackle being only £250—and the easy application of the engine to other purposes; also its adaptation to hilly or uneven ground and to irregular fields.

A very fair and impartial comparison of the rival systems of cultivation by steam—the direct and roundabout—is found in the Gardeners' Chronicle, (English,) of December 4, 1869, from the pen of Mr. Aveling, of Rochester. He remarks that—

Of the many schemes and systems which have been practically brought before the public, two only (and those the simplest) have proved thoroughly successful. In both of these the traction power is transmitted to the implement through a steel wire rope winding upon a drum. In the one case the two winding drums are fixed in a windlass frame, and connected to a stationary steam-engine, and can be worked from one corner of a field, the rope being led all round the land intended to be plowed, through pulley sheaves anchored in convenient positions. One end of each rope being made fast to the plow, the implement is drawn backward and forward, by the drums pulling alternately, and the pulley sheaves and anchors at each end of the furrow are moved forward as the plow proceeds.

In the other system each of the winding drums is placed under the boiler of a self-moving steam-engine, and one engine at each end of the furrow working alternately and pulling the plow toward it, the other moving forward into position, ready for the return of the plow.

These two systems are known as the single engine, or roundabout, and the double engine, or direct system of steam cultivation. The advantages of the roundabout system are in the cheapness of the machinery, as the tackle can be driven by an ordinary portable engine, and its superior fitness for very hilly and awkwardly shaped fields. Its disadvantages consist in loss of power, great length of wire rope, useless expenditure of time in removals, and great quantity of apparatus necessary.

The advantages of the direct system are, short length of rope required, and consequent economy of power, the little time taken in getting to work, and the small amount of wear and tear, due to the simplicity of the tackle. Its disadvantages are its first cost, the width of the headlands left, and the difficulty in moving the engines on wet land, though the last difficulty has almost entirely been removed by increasing the width and diameter of the driving wheels.

For large farms and for letting for hire the double engine or direct system is the best, and has proved itself capable of doing more work per day at a less cost than any other. With this tackle I find, from experience, that ten acres can be plowed from eight to nine inches deep in a day of nine hours, in ordinary soils, with a pair of twelve horse-power engines and a six-furrow plow, at a cost, in no case, exceeding the following estimate:

	£	s.	d.
Chief engineer	0	5	0
Second engineer	0	4	0
Plowman	0	4	0
Assistant plowman	0	3	0
Two boys	0	4	0
Fifteen hundred-weight of coal	0	15	0
Water	0	7	6
Oil, &c	0	2	6
Depreciation, renewals, interest, &c	1	10	0
Total cost of ten acres	3	15	0

Or 7*s.* 6*d.* per acre. The lowest price at which this work could be done by horse-power is 15*s.* per acre; many farmers having stated it would cost them 20*s.*, and having offered me that sum per acre for one hundred acres of land similar to that referred to above.

IMPLEMENTS.

Every year increases the variety of implements employed, and witnesses new adaptations of steam power to the operations of the farm.

Few light land plows of six or eight furrows are in profitable use. A cultivator twelve feet wide is popular, constructed with hinges, on the principle of the jointed harrow, so as to adapt itself to inequalities of surface at that great breadth. This implement is worked by two en-

gines, and instead of being balanced or double, turns (with the aid of the engine) at the end. The London Times reports, as the result of one hour's run in a given trial, in a light soil, previously broken, and working six or eight inches deep, the effectual stirring of five and a half acres.

Strong, broad harrows, for cultivation in spring, upon land that has been thrown up roughly in the autumn by the "digging breasts," are much used; and for the harrow can be substituted rollers, clod crushers, and other implements.

A very strong grubber, worked like the cultivator, is very efficacious in clearing the soil of roots and stones. It is also valuable as a subsoiler, penetrating readily to the depth of eighteen inches.

A draining plow, which may be used as a mole plow, or to put in pipes, can be worked to the depth of three feet or more. Steam pumps are also found useful on the farm, and the engines may be employed in supplying power for a great variety of farm operations.

COMPARATIVE ADVANTAGES OF STEAM CULTIVATION.

At a meeting of the Hexham Farmers' Club, (England,) held in December last, a paper on "Steam Cultivation" was presented by Mr. Greig, from which we take the following extracts, adding the comments of some other members, as found in the Farmers' Magazine for December, 1868:

Regarding the application of steam as a pulling medium, I think there can be very little discussion. Where steam power can be conveniently applied there is no doubt of its being done at one-tenth the cost of horse labor. A steam-engine, set in position, drawing a wire-rope, will pull at 6*d.* per horse-power per day. If such be the fact, (and I can prove it to be so by numerous cases in collieries and other places where wire-rope is now being used,) there can be no dispute as to its efficiency. With practical men, therefore, it resolves itself into a question of application. The draught of a horse is about a hundred-weight and a half continuously, and with steam this draught can be carried continuously ten hours for 6*d.* Steam plowing is largely a matter of pulling; and provided the necessary pulling power be obtained, the next consideration is to arrange the conveyance of this power in such a way as shall be most suitable for the use of the agriculturist.

The present position of steam plowing is somewhat peculiar. It is an admitted fact that on steam-cultivated land the crops are very materially increased, where judicious management is obtained, and those people who devote a reasonable amount of thought and energy to the work are succeeding and making money. On the other hand numerous farmers, possessing machines of their own, are not so successful; but this, be it observed, is owing entirely to the management. Steam power is not at present in the advanced position it should occupy, partly owing to the want of implements to do the light work. Heavy work can be done by it under all circumstances, much better and cheaper than by horse-power. One of the great advantages of steam plowing is that in all cases the drainage is thereby materially improved, and it is a noteworthy fact that in several instances where steam plow proprietors, having experienced great difficulty in getting work from the farmers during the first year, the second year they have had more applications than they could well supply. * * * * * Before the cost of steam cultivation is reduced to the maximum of economy the fields will require to be enlarged, and good roads must be constructed; but even under existing circumstances, if the proper class of machinery be procured, and well-managed and worked, the result will be more or less advantageous.

Mr. Younger stated that he had a steam plow with two engines. His farm was strong land, and he could plow six to twelve acres a day. He had done away with five horses out of sixteen.

Mr. Stephenson said that at Cirencester College the steam plow was rather old-fashioned, and not to be compared with the machine spoken of. It was a ten-horse engine, with an anchor. At the College the steam plow cost them something like £300 a year, but the farm was, perhaps, one of the worst in the kingdom.

Mr. Cockburn said that a gentleman at Hylton, farming about seven hundred acres, had got a single ten horse-power engine; he had had the engine about six months, and he was now able, as a result, to do with half the number of horses. He used to have nineteen; generally one-third of the horses were done away with.

Mr. Goodrich said that Mr. Crow, who had a steam-engine, had reduced the number of his horses from thirty to sixteen or eighteen. He farmed 1,150 acres.

The chairman said it was stated that the whole operations could be done at 8*s.* per acre per year; he wished to know how the amount was arrived at.

Mr. Cockburn said that a few days ago a set of Mr. Fowler's tackle had been commenced with on a farm, and during two days twenty-one acres were plowed to a depth of ten or twelve inches. The cost of coal for the two days was £1 3*s.*; water, £1; engineer, 25*s.* per week; second engineer, 21*s.* per week; plowman 20*s.* per week; two boys at 1*s.* 6*d.* each. He considered that out of the twenty-one acres, leaving headlands out, there were eighteen acres plowed, at a cost £3 15*s.*

Mr. Younger said that he started at six in the morning to raise steam, and commenced work at half-past seven. It took about an hour to move from one field to another.

Mr. Cockburn said that a few days before they fired up two of the Fowler engines and started out of the station in three-quarters of an hour. They moved from one field to another, two fields distant, and were at work in three-quarters of an hour.

Mr. Wigram said that they always tried their engines to go up a short bank at a gradient of 1 in 10. No difficulty was found with an ordinary hill; in slippery weather they might get into difficulty.

During the three years which have elapsed since the Steam Cultivation Committee of the Royal Agricultural Society made their report, great advances have been made in England toward perfecting the steam-plow. The circular of Messrs. J. Fowler & Co., dated July, 1869, states on this point, that steam cultivation is very different now from what it was three years ago: "In fact, we are now doing with our machines, in all cases, twice as much work, and in some cases three times as much as was done at the former period. They are also working at a great disadvantage, as a great number of our machines are constantly working for hire, and are only employed to do the heaviest work. Indeed, machines made four years ago would never have been able to do the work which has been done this last summer. It is a great mistake in speaking upon the subject to refer only to work done two or three years since, as the machines since then have been greatly improved, and, moreover, the men employed were then in a very uneducated state."

For the purpose of furnishing data from which our farmers may estimate the cost of working similar machines in this country, the following additional bills of costs are given:

Mr. Smith, of Molston, places the cost of a full set of his own tackle, the roundabout, as follows:

	£
Four-wheeled windlass, with anchors, match blocks, and rollers, complete	110
Fourteen hundred yards best steel wire-rope, extra quality	70
Five-tined cultivator	21
Ridging and subsoiling plow	21
Ten horse-power portable engine	300
Total	522

He gives the cost of preparing his ground for seed, including "smashing," ridging, and subsoiling, as follows:

	£	s.	d.
Eighty-eight acres of smashing—for labor, coal, and oil—eleven days	13	16	10
One hundred and thirty-seven acres of ridging, and subsoiling—for labor, coal, and oil—twenty-seven days	36	13	6
Interest at 5 per cent. on £372*	18	14	0
Wear and tear in thirty-eight days' work	8	8	0
Total	77	12	4

Or an average of 6*s.* 10½*d.* per acre.

Recent statements made by English farmers give an idea of the value and practicability of these machines. The Oxford Steam Plowing Company state that they average twenty to twenty-two acres per day with each set; working eight to ten inches deep—in some places twelve to fifteen inches—requiring on an average one to one and a half hundred-weight of coal per acre, and four to six barrels of water, each barrel holding two hundred and fifty gallons. The farmers all like the work, and the demand daily increases. This company works five sets of No. 2.

Mr. Wicksteed, with a set of ten horse-power tackle, accomplished, between March and October, sixteen hundred acres of plowing and cultivating.

Mr. R. Toeffer states that three sets of fourteen horse-power, after four seasons' work, nearly repaid the original cost, and the machinery is nearly as good as new. He regards as a great improvement the steel-geared twenty horse-power tackle of Messrs. Fowler & Co.

Mr. Henry Yates, who is working seven double sets, and has had an experience of five years with steam machinery, cultivates on an average about 2,000 acres per set, at an average price of 10*s.* per acre. He uses twelve to twenty hundred-weight of coal per set in ten hours. He reports his largest week's work at 125 acres from 9 a. m. Monday to 12 noon Saturday, on light land; and that the daily work accomplished usually varies, with the soil and depth, from twelve to thirty acres with the cultivator, and from seven to twenty with the plow.

Mr. Arthur Carey employs four men with each set of tackle; uses about one ton of coal per day and five barrels of water. He averages about eight acres of ten inches deep plowing in heavy clays, and about twelve to fifteen cultivating.

Mr. H. W. Furniss, Yorkshire, an operator in steam cultivation, charges for "digging" strong lands, ten inches in depth, 14*s.* per acre, and 12*s.* for lighter culture; and for "cultivating" from 8*s.* 6*d.* to 9*s.* 6*d.*, according to the tenacity of soils.

Mr. Bellhouse, York, pulverizes from ten to twelve inches in depth with a seven-tined cultivator, at 9*s.* 7*d.* per acre.

Mr. Coates, on the farm of Lord Vernon, plowed 773 acres in one hundred and ten days; cultivated 1,114 acres in one hundred and twenty-two days, and harrowed 1,174 acres in forty days.

The North Lincolnshire Plowing Company, with three sets of apparatus, report the cultivation of 2,200 acres in 1,866½ hours' work. Their rate of charges is 10*s.* to 15*s.* in heavy soils, and 7*s.* 6*d.* to 10*s.* in light lands.

Smith and Langsford, North Thoresby, with a double engine, claim to have plowed 173 acres at the rate of eight acres daily, and cultivated 1,049 at the rate of fifteen acres per day.

* Mr. Smith charges interest on the tackle and half the engine, the latter being used for thrashing, &c. Part of the interest and part of the wear and tear should, therefore, be charged to the account of thrashing.

Thomas Porter, near Cirencester, plows at the rate of fourteen acres per day; cultivates thirty acres, and "drags" fifty acres per day.

Draining.—It is one of the chief advantages of steam cultivation that the thorough and deep cultivation of the soil by "smashing" and cultivating with the ponderous implements employed in heavy lands facilitates drainage and makes an improvement that is apparent for years. It is the common observation of those conversant with steam culture that there is apparent in the condition of fields a manifest difference between those cultivated by the new and the old modes. Pools of water are common upon the surface of horse-plowed land, while adjoining fields, cultivated deeply by steam, are dry. The same difference has been remarked by Mr. Lawrence in Louisiana. The money value of drainage, by such means, throughout an entire State or country, would amount to many millions of dollars.

INCREASE OF YIELD BY STEAM CULTURE.

It is important to ascertain that cultivation by steam may prove less expensive than that of equal depth and thoroughness by horse-power; yet, if it can be shown that it costs even a little more, and is followed by a larger production, it may prove practically the cheaper mode. The testimony of observers is uniformly to the effect that an increase of yield is effected. Mr. Aveling, of Rochester, England, says that "a very considerable increase in the yield, amounting, in many cases, to as many as three sacks per acre, has been found to result on the application of steam power to the cultivation of heavy clay lands; and this is not surprising when we consider the damaging effect to the drainage of such lands, caused by four horses following each other in the furrows when plowing it, and the low temperature of the soil consequent upon the water being unable to find its way to the drains." Mr. Smith, of Woolston, claims an increase of fourteen bushels of wheat per acre. Mr. Wallis, farm bailiff of the Duke of Manchester, finds, in his experience, an increase of four bushels, and a gain of two shillings per quarter on account of superior quality. Mr. George Armstrong, Graffham, St. Neots, says he could not have maintained himself upon his farm but for steam culture. Mr. Henry Yates, an extensive operator in steam plowing, estimates the increase of wheat in fields cultivated by steam, within the range of his observation, at eight bushels per acre. The London Times has reported a yield of forty-five bushels per acre on drained and steam-plowed land, while the adjoining farm, also drained, but horse-plowed, produced but thirty bushels per acre; and a neighboring farm, neither drained nor steam-plowed, gave but twenty bushels per acre. The letter of Mr. Lawrence, quoted in this article, also gives equally favorable testimony, showing that an increase of 1,000 pounds of sugar has been attained the present season in Louisiana by steam cultivation.

These statements are highly encouraging, though a wider range of experience will be required to demonstrate the extent and value of this increase of product.

THE AMERICAN STEAM PLOW.

A review of attempts to produce a successful steam plow in this country may aid in forwarding that inevitable consummation. The following considerations, though not presented as official, are those of one who has given much thought and investigation to the subject. As a

people, we are wont to boast of our great strides in the field of progress. In one hand we hold up the certificate of the infancy of our years, and with the other, with becoming pride, we unroll to the gaze of the world a voluminous scroll, setting forth our wonderful achievements in all that makes a nation great and powerful, and yet, with all our amazing progress, there is no such implement known as a practical American steam plow. American sod is successfully turned by a steam plow, but that plow is of foreign origin. We are compelled, at an immense outlay, even after Congress remits the duties, to send our orders three thousand miles across the ocean to procure a steam apparatus that will do all that is claimed for it. True, we may say, that this same apparatus was first invented and patented in the United States, by E. C. Bellinger, of South Carolina, November 19, 1833,* and was improved upon by John Fowler, of England, in 1854, twenty-one years after Bellinger had created the infant Hercules. So Columbus showed others how to discover unknown worlds, and as the Spaniard lost foothold in territory of his own discovery, so have we, by like supineness, lost the glory of successfully introducing to the admiration of the world what should have been known as the American steam plow.

It is proposed by a general review of the reported attempts at steam plowing in America, to show by the documents and the construction of the machines themselves, that there existed inherent causes of failure, and, by calling attention to the main features connected with these failures, to point out, if possible, in a practical way how success may be achieved.

In a glance at what has been done by Americans in the way of cultivation by steam, we shall be struck with the predominant idea of "going ahead." While the greatest performance claimed by any English implement is one acre per hour, or eight or ten acres a day, except with a light cultivation, we find American machines promising to plow sixty acres per day. It will be seen that in nearly every attempt at operating these implements the experiment closed by the breaking of some part of the machinery. The United States Agricultural Society, in its premium list for the exhibition at Chicago in 1859, offered the grand gold medal of honor "for that machine which shall supersede the plow, as now used, and accomplish the most thorough disintegration of the soil, with the greatest economy of labor, power, time, and money." An award was made to Fawkes's steam plow, of $3,000 offered by the Illinois State Agricultural Society, in connection with the Illinois Central Railroad Company; and thus this implement is placed at the head of the list of American cultivators, and claims particular attention.—[See engraving in Agricultural Report 1867, page 259.]

The striking peculiarities of this machine seem to be that it is a locomotive, running on a large roller or drum instead of wheels. The engine draws a gang of eight plows, though it is manifest that the number is unlimited. The great desideratum is a locomotive, the use of which will be practicable on a reasonable proportion of land, and, at the same time, cheap and durable. Fawkes's implement plowed at the rate of one acre in seventeen minutes, or three and a half acres per hour. There was some detention by the clogging of the plows. It would seem that, after plowing about two acres, the steam got too low, and the committee suggested some improvement as an expedient for increasing the power of the engine. We add a description by the committee that conducted the trials of the steam plows at the fair of the Illinois State Agricultural Society.

* Agricultural Report 1867, p. 255.

To form a complete idea of a steam plow, let the committee recall the appearance of a small-sized tender of a locomotive engine. Let about half the forward portion of the sides and tank be removed. We now have something which resembles the body of Fawkes's machine. In the middle of the forward portion of the platform stands the upright boiler, which is about six and a half feet high and four feet in diameter; the fire-box and ash-pit being, of course, below the level of the platform, and the fire-door opening forward. The boiler contains two hundred and twenty-one-and-a half-inch tubes, which computed, together with the fire-box, gives three hundred and seventy-five feet of fire surface. Steam may be got up in fifteen minutes, although twice that time is usually necessary. The fuel may be either bituminous coal or wood. The cylinders are horizontal, nine inches in diameter, and fifteen inches in stroke, and are placed one on each side of the boiler. The pistons communicate motion, not to the side-wheels, but to the drum or roller, six feet in diameter and six feet long, which, as the sides of the platform overhang its end, is comparatively out of sight. The drum is placed about midway between the front and back of the machine; before it, depends the fire box, and over and behind it is the tank, so that when the boiler and tank are full they nearly counterbalance each other on the axles of the driving-drum. * * * In front of the fire-box is a short, tapering bow of sheet-iron, which serves as a seat for the fireman, and a receptacle for fuel. The bow is supported by a body-bolt on a truck composed of two iron guide-wheels, three and one-half feet in diameter, and fifteen inches broad. The truck is controlled by a steering-wheel, in charge of the engineer. * * * The engine is thirty horse-power. The entire length of the machine is eighteen feet, (by eight feet wide;) its weight, with water and fuel, ten tons; and cost about $4,000. The tank holds twelve barrels, sufficient for three hours' running.

Says another writer:*

Fawkes's steam plow has attracted the most attention at the West, and, as it contains the idea of a traction engine to draw the plow after it, may be considered a fair exponent of this kind of plowing. This implement was first tested at the State Fair of Illinois, at Centralia, September 17, 1858. * * * The plan of trial was on level land, baked hard by the summer drought. * * * To this, six plows were attached, cutting a foot each. The success was complete under such favorable conditions, and the crowd of people in attendance greeted it with rounds of applause.

The next public trial was at Decatur, Illinois, in the month of November. There the conditions were less favorable. The ground was moist and the sloughs soft. The failure there was as signal as the success at Centralia had been two months previous. The difference between the level, sun-baked surface of Egypt, and that of the friable clay loam of Central Illinois was a wide one, and the people in attendance went home disappointed.

The next trial was made at Freeport, at the State Fair of 1859, with a new engine and such improvements as would seem requisite to overcome the difficulties found in the yielding loam of the northern prairie; but another disappointment followed. * * The next week it was tried at the United States Fair at Chicago, in competition with Waters's steam plow. Neither of them met the expectations of the people, and the laurels gained at Freeport by the premature judgment of the scientific committee (?) were nearly lost.

The Illinois Central Railroad Company had offered a premium of $3,000 for a successful steam plow. The plow was to be tried at three different points. The first point was on the writer's farm. The ground on which it was tried was undulating, uncultivated prairie, in all its native wildness, being part of an inclosed field on which no stock had been permitted to graze. In getting to the field, a soft, low piece of ground had to be passed over. This land was not so soft but that a team could easily haul a ton over it. The weight of the engine sunk the drum so deeply into the soft soil that it could not be passed over by the aid of steam. This was the first serious failure in that trial, demonstrating that this machine could not pass over low prairie, even when the turf was unbroken, for the drum, as soon as the steam was applied to it, would bury itself too deep for extrication, though the same machine might have been hauled over with other power.

Says Professor Brainerd:†

The application of steam power to the propulsion of machinery, for the purposes of travel and transportation, has been proved a success far beyond the most sanguine expectations of its warmest advocates. Animal power cannot compete with it. It is as untiring as the sun in his course; and, when its day's work is done, it needs no rest, but is ready at a moment's warning to renew its task. * * * * * No portion of the globe is better adapted to steam culture than the broad prairies of the West; and it is upon these plains that the great problem of steam culture must be solved.

*Agricultural Report 1863, p. 420.
† Agricultural Report 1867, p. 254.

* * * Efforts at improvement (in America) have been directed chiefly to the construction of an engine capable of traversing the field and drawing a gang of plows, but, hitherto, insurmountable difficulties have been experienced. It has not been found impracticable to construct an engine capable of running over a common road; but in a cultivated field, where the soil is soft and yielding, it has been found that nearly the entire power of the engine has been expended in its own propulsion, and hence its inability to overcome the resistance of the plows. * * * *

The method of steam culture patented by E. C. Bellinger, of South Carolina, and improved upon by Fowler, of England, is probably the most feasible that has been attempted. But this plan, under the most favorable circumstances, is open to objections; and in many situations cannot be brought into operation. If a traction engine could be constructed upon the plan previously indicated, it would supersede Bellinger's and Fowler's plan of dragging the plow across the field by long ropes. * * *

In the early attempts at steam plowing, the great difficulty in the way of success, as before stated, was *traction*. * * * Among the steam plows invented in this country, that of John W. Fawkes, of Lancaster, Pennsylvania, has, probably, attracted the greatest attention. The accounts that have been published of its power and performances seem, however, almost fabulous. Certain it is that the expectations and promises of its friends have not been realized, although ten years have elapsed since the date of the patent.

Fawkes's locomotive was of the high-pressure kind, and carried two steam cylinders of nine inches in diameter each, with fifteen inches' stroke; consequently, the maximum force was about eleven horse-power. The weight of the locomotive was seven tons; about five of which rested upon the journals of a traction cylinder, six feet in diameter and six feet in length. The amount of effective earth contact (or traction) was therefore only seventy-two inches. * * * Fawkes's engine, in order to come up to the standard of an ox team of equal tons' weight, should have had an increase of traction contact of one hundred and eighty-four inches over the seventy-two of the driving-wheel, thus equaling two hundred and fifty-six inches, (which is that of the ox team of equal weight,) about a hundred less than the estimated power of Fawkes's engine required to develop its full working capacity of eleven horses. Hence it follows that Fawkes's locomotive should have had a traction surface of three hundred and fifty-two inches instead of seventy-two; and to this deficiency may be attributed his want of success. * * * * * *

A steam locomotive for farm purposes should be so constructed as to be available for other purposes than simply plowing and cultivating the soil. Its failure in this regard would be fatal to its profitable employment.

The errors in the attempts yet made in steam plowing have arisen, perhaps, from making the steam engine too heavy, and on too large a scale. That the steam engine is destined to supply the place of animal power, at least in a great degree, in agriculture, there can be no doubt, and thus effect a great reduction in the expense of working the lands, and become a powerful instrument in augmenting the productiveness of the soil.

That engines can, and have been, constructed, possessing the requisite amount of power, no one will for a moment question. The main object to be aimed at is to make them less unwieldy, and this can be done only by following out the indications of nature, both by the reduction of the weight of individual machines, and in the relative increase of traction surface.

The next implement in importance to Fawkes's is that of James Waters,* of Detroit, formerly of Pennsylvania, who has invented a steam plow which, at Chicago and elsewhere, has attracted much notice. It is thus described by a correspondent of the Country Gentleman:

This machine has four cylinders five and three-fourths inches in diameter, the stroke of the piston being twelve inches. The boiler, which is the one used on locomotive engines, is six feet in length, with one hundred flues, and can bear a pressure of two hundred pounds to the square inch. The driving wheels are ten feet in diameter, and twenty-six inches on the face, each braced with two sets of iron spokes athwart each other. They are turned by means of a pinion, connected with the main shaft or axletree, which works into an internal gearing of the size of the inside diameter of the wheels. On the outside, pieces of iron are attached, to prevent the wheels from slipping. There are two leading wheels, five feet in diameter and thirteen inches on the face. The weight of the whole machine is seven and a half tons. * * * Two men are required to work this engine; one to steer, and the other to attend to the fire. Its working power is one hundred and fifty pounds of steam, while it can be worked with only fifteen or twenty pounds. Underneath the boiler is an iron tank, and a fire-

*Agricultural Report, 1859, p. 258.

box. There is also a tender, which is used for carrying both wood and water. Frye's gang plow * * * " is the only kind of plow which this machine has drawn yet. * * Mr Waters states that the width of the cut, counting thirteen shares (!) is nineteen feet, and that he can plow sixty acres a day.

At the trial at Chicago, thirteen plows, in three gangs, were used, hitched one behind the other; which with the engine, tender, and water cart, made a train of thirty-seven feet in length. The machine, after showing its locomotive power on the track, was put to its trial on the prairie, and made an astonishing start, turning a breadth of furrows of nineteen feet at one operation, and running three hundred feet in two minutes, or at the rate of an acre in sixteen minutes, when the performance came to an end by the breaking down of the machine. It seems manifest that Mr. Waters's machine is too cumbersome and expensive; and equally manifest that he failed for want of care and skill in operating his implement, rather than in the principle of his plow. An obvious objection to this machine is its great length, which renders it unfit for small fields, and the fact that it does not finish up its work, but leaves a strip of fifty feet in the middle to be finished by horse-power.

By the report of the committee, it appears that two substitutes for the plow were offered for examination, but no account of the performance of either has been published. One of these was offered by John Van Doren & Co., of Chicago, and is described as a "rotary cultivatoı driven by steam, and self-propelling." Besides plowing it may be applied to other uses, such as harvesting grain, cutting grass, and, having a pulley of suitable dimensions, may be used as stationary power for farm machinery.

The other, say the committee, offered by B. F. Field, of Milwaukee, Wisconsin, is a "revolving plow and seeding machine," and is thus described:

There is an outer slatted drum of iron, four and a half feet in diameter and five feet wide, made in three sections. Inside, on an eccentric shaft are fixed three sets of twenty spades each, set eight inches apart on spiders, all turning on one shaft. As they come in turn below, the spades project beyond the outer drum, through the apertures, and the weight of the machine, two tons, being thrown upon them, they enter the ground to the depth of eight inches. The machine turning as it travels forward, the spades, coming behind, lift the earth as they emerge, and disturb its relative position, as would a spade in the hands of a man, except that the soil is not inverted. Behind the spading apparatus, on the back of the frame which surrounds the whole, is a row of ordinary drill sheaths to deposit the seed in the ground, which is fed to them by suitable hoppers with valves.

Among the various appliances to overcome the difficulties from want of traction, may be mentioned the "revolving screw," operating not unlike the screw propeller in steamships. Experience has shown, however, that the friction of the blade upon the soil consumes too much of the power of the engine to make its use successful as a means of propulsion. A patent was granted to J. R. Gray, in 1857, for a machine of this character.

About the year 1858, Thomas H. Burridge, of St. Louis, Missouri, invented and built a traction steam-engine, intended chiefly for field culture, which is described as follows:*

It consisted, of a large cylinder of about ten feet in diameter, and ten feet in length, made of heavy boiler iron. A shaft was supported in the center by means of rods or spokes at each end, and at equal distances from each end, was secured an interior cog-gear. Upon the shaft was suspended an iron platform, which preserves its pendent position by reason of its gravity. Two reciprocating steam-engines were mounted upon the suspended platform, and by means of a pinion cog-gear, operated by cranks from the engines, which cranks were placed at an angle of 90° from each other, the pinion gearing into the main wheel upon the inside of the cylinder, rotation and progressive movement were established. A gang of plows was attached to a frame work in the rear of the traction cylinder, by which it was connected by arms extending backward from the central shaft. The practical operation of this engine showed that it possessed sufficient traction power for the purpose intended, but its unwieldy character, and its want of adaptation to the performance of the work of a stationary engine, formed obstacles to its introduction into general use.

*Agricultural Report, 1867, p. 257.

The next on the list is a steam plow for which, in 1863, A. W. Hall, of St. Louis, Missouri, took out a patent:*

This machine is so nearly allied to cable traction as to render it worthy of notice, in which the points of novelty were directed to means for overcoming the hitherto insurmountable difficulties experienced from want of traction. The locomotive consisted of a frame-work, supported upon four wheels, of suitable strength to bear the weight of the boiler and other parts of the machine. As the inventor did not depend upon the weight of his locomotive for traction, it was built as light as was consistent with the required power.

There are two sets of rollers placed horizontally in pairs, transversely to the frame of the machine, and rotated, in opposite directions, at a uniform speed, by means of two sets of cog-gears, which are driven by two reciprocating engines, located upon opposite sides of the boiler. The rollers are grooved in the center to receive a rope, which passes between them, and is held from slipping by the strong bite of the rollers. The rope is anchored at each side of the field to be plowed, the anchors being moved forward on headlands as the plowing progresses.

The plows are attached to the frame of the locomotive, which moves back and forth over the field by means of the bite of the rollers upon the rope, as before described. It will be seen that the rope forms a flexible track for the engine, the weight of which is supported upon ordinary bearing wheels, the progressive movement being due to the action of the rollers upon the rope. This plan differs in no important particular from Bellinger's, and other cable traction plows, except that the latter use a windlass instead of biting-rollers; and that in Hall's the engine moves across the field, while in the others, it is stationary during the plowing of a furrow.

The last on the list of patented steam apparatus that has been actually built and tested in the field, and on the performances of which reports have been published, is a steam cultivator or triturator,† patented May 10, 1868, by P. H. Standish, of Martinez, California, which is quite novel, and for which its friends claim much merit; though, of course, it has not yet passed the ordeal of extended practical test, and must have time and experiment to prove whether it is a success or not. It is propelled by an ordinary steam-engine placed upon a form, or frame-work, stationed on wheels to carry and guide it, while the digging apparatus is geared directly to the engine by crank, drum, and pinions; so that less power is required to work the machine. The peculiar features of this apparatus consist in the manner of cutting or breaking the ground; it is not done by shares turning furrows, nor by spades lifting and dumping the earth; but by four knives, or spits, set at right angles vertically in a head-block of cross-bars, revolving horizontally in a perpendicular shaft, tearing and stirring the earth in a transverse direction to the movement of the machine, something in the manner of a rotating harrow. Two or three, or more, of these implements are worked, and follow the engine according to its power, and as may be desired. It is a question whether this machine will work well in sod, or turf, or original breaking up.

Having now gone over the entire ground of all the recognized and reported trials of "attempts at plowing by steam in America," let us candidly and impartially examine each case, and endeavor, with the lights before us, to ascertain, if possible, the main probable causes of failure. In doing so it will be of the first importance to criticise the means employed, together with the weight, size, and power of each engine, in order that future inventors may be enabled to see the defects of their predecessors, and, possibly, through such experience, remedy them. In doing so we shall study to present a fair statement of each case, drawn from the facts and figures as published; and will avoid all reflections not absolutely demanded for the illustration of the subject.

First in the list we find the apparently well-proportioned engine of Mr. Fawkes. The report of the committee at the fair of the Illinois

*Agricultural Report 1867, p. 260.
† Agricultural Report 1867, p. 276.

State Agricultural Society informs us that the length of the machine is eighteen feet, and the width eight feet, (its weight, with water and fuel, ten tons,) and it has thirty horse-power. The boiler is six and a half feet high and four feet in diameter; the tank holds twelve barrels, or three hundred and sixty gallons, of water, weighing 2,880 pounds. The driving drum is six feet in diameter and six feet long, the face of which is perfectly smooth; and, according to Professor Brainerd, relying solely on seventy-two inches of traction contact for self propulsion, and dragging eight plows, presenting a resistance of nine hundred and sixty square inches. In addition to its own weight, we have to add the actual weight of these eight plows, independent of their resisting weight; for two huge beams, attached to the top and sides of the water-tank, and extending away behind, performed the office of supporting the gang of plows suspended from them. Consequently the engine was required to drag against the forward resistance of the plows, and also to contend against the downward pressure brought upon it simultaneously by the united weight of the plows themselves and the rising sod upon each mold-board. Here, then, at once is a glaring fault, for what practical farmer would strap a frame upon the top and sides of his horse's back, and suspend the plows from it? This stricture might be met with the argument that weight is needed to obtain traction. We think the results sufficient to prove this fallacy. The traction to drive a steam plow will, probably, be obtained neither by weight nor surface, but by positive resistance. The chief defects of this machine were its huge proportions as to size, height, and weight—no traction worthy of notice—a single drum, which, in turning curves, must have strained the engine severely, by reason of the necessary "slip" at its pivot; and, as a witness of its performances stated to the writer, the plows actually "anchored the engine" when they entered the ground. Mr. Dunlap, of Illinois, says that the ground upon which it was tried, upon his own farm, was slightly undulating, uncultivated prairie; and, in getting to the field, a soft low piece of ground had to be passed over; that this land was not so soft but that a team could easily haul a ton over it, and that the *same* machine might have been hauled over with other power, but that the weight of the engine sunk the drum so deep into the soft soil that it could not pass over.

Here we have the case of a want of traction resistance practically illustrated. Had the engine possessed traction equal to its weight and power, it would have passed over such an ordinary spot too rapidly to mire itself. The action of the slipping drum had the effect of puddling the moist ground, and thus rapidly created a bog. Let the reader recall to mind a heavy wagon, drawn by a poor team, stalled under similar circumstances, and the case is fairly presented. In conclusion, however, it must be admitted that had Mr. Fawkes possessed a clear idea of traction, with less ambition as to size of machine and amount of work to be accomplished, and placed his plows upon an independent carriage, together with a few simple alterations in his engine, he might have entirely succeeded.

The besetting weakness which seems to have possessed the minds of these pioneers of the steam plow was, evidently, that "high vaulting ambition, which o'erleaps itself and falls on t'other side." Engines of elephantine proportions and weight, with an inordinate desire to accomplish wonders, were the irresistible temptations that illured them to failure. We find James Waters taking the field with a structure thirty-seven feet in length, supported upon driving wheels ten feet in diameter; a boiler six feet long, carrying coal and water, and followed by a train of

thirteen plows, intended to cut a breadth of nineteen feet at one operation! We find this machine doing the "holiday exercise" of going around the track of the fair grounds with almost a prancing alacrity; but the committee request the inventor to pass out from the "show grounds" into the fields of useful labor.

The committee tell us, with true discernment, that Mr. Waters's machinery is too cumbersome; and that he failed more from want of care and skill in operating his plow than from fault in its principle. Mr. Waters was superior to Mr. Fawkes in this: he evidently understood the principles of traction, but had no judgment in construction and proportion.

Following upon the heels of these failures comes Thomas H. Burridge, of St. Louis, Missouri, who perpetrates a similar error by constructing another colossus. Professor Brainerd tells us that Mr. B. built a traction engine, intended chiefly for field culture, consisting of a cylinder ten feet in diameter and ten feet wide, of heavy boiler iron; that a gang of plows was attached to a frame in rear of the traction cylinder; and that the practical operation of this engine showed that it possessed sufficient traction power; but its unwieldy character and want of adaptation to the work of a stationary engine, precluded its general use.

Here is presented an almost parallel case illustrating a knowledge of traction, but want of judgment in proportions and the absence of a certain instinct of the fitness of things for certain purposes, only to be acquired by the practical man. Whenever a man shall unite the virtues of these three implements, and avoid their faults, and, at the same time, endow his creation with the faculty of performing the general functions of a steam-engine, other than that of plowing only, it is fair to predict that we shall witness the birth of the coming American steam plow and farm engine. Further, should he succeed in uniting, in harmonious combination, Bellinger's cable traction, and the field or locomotive traction, it would be reasonable to expect that, under no circumstances, could he fail to accomplish all the requirements of a good and reliable apparatus.

We fully concur with the opinion expressed by Professor Brainerd, that "the common plow has, from time to time, been so much improved, that it may be accepted as the most perfect implement for preparing the ground for a crop. * * If, instead of futile attempts to invent and construct implements intended to supersede the plow, the inventor should direct his attention to an improvement of the means for its economical use, by steam power, we might hope for results commensurate with the importance of the subject."

Let any one obtain, and carefully study, what the Mark Lane Express (England) pronounces the most thorough exposé of the art of plowing ever contributed to the English language, viz: "The Report of Trials in Plowing, issued by the New York State Agricultural Society," and then let him go into a sod or stubble field, with a good mold-board plow, and any of the new-fangled triturators, and we think that a short experience in "running the two machines" will speedily convince him that an implement which has held its own almost from the birth of man, and has been proportionately improved to meet his growing wants, is not to be superseded in a day by an inferior system of culture. Spade husbandry is a very good thing in its place, and on a small scale; but every practical farmer knows that blue grass or clover or timothy sod, if it is to benefit the land and the crop, must be inverted and not triturated, in order that the vegetable matter may be buried below the surface, so that decomposition may take place, in the first instance; and,

in the second, that a clean surface may be obtained for properly putting in the grain and giving it a due start of all foreign growth. Every practical farmer knows that no other implement than a good plow can do this, except a digging hoe, which also requires three motions—the blow, the jerk, and the upset. When a machine can do this, the plow may, possibly, be superseded. We do not mean to say that a gardener cannot invert sod with the spade, but farmers are not gardeners. No digging or spading machine, which fails to invert the sod after the manner of the plow or hoe, can ever hope to be generally popular among practical men.

In the effort to compass this great and coveted end, a practical steam plow and farm engine, would it not, be wise to follow the dictates of nature, as near as may be consistent with art? Let us take for our text the machine which is the connecting link between the common walking plow and the much desired steam apparatus. Let us mount one of those superior implements, an Illinois steel gang plow. This machine has two plows attached to its frame; each plow turns a furrow twelve inches wide, and will average a depth of eight inches, thus making, in their united work, a furrow twenty-four inches wide and eight inches deep. Four good horses draw this gang plow of two plows to the above-named depth with comparative ease, and accomplish about five acres per day of ten hours, which would indicate a speed of about two miles an hour.

The resistance offered by these two plows in their progress is equal to 24 inches × 8 inches = 192 square inches, allowing that the four horses have eight feet at a time in contact with the ground, and that each hoof has a traction contact of twelve square inches. This would give as a traction result of the united four horses, 8 inches × 12 inches = 96 square inches of traction contact to overcome the resistance of the two plows.

We have seen that the plows open a united furrow 24 inches wide by 8 inches deep, or 192 square inches; from this, if we deduct the traction of the four horses, viz., 96 square inches, it leaves 96 square inches to be overcome by the muscular power of the horses, which would be equal to 50 per cent.

Each horse weighs about 1,000 pounds, which would aggregate about 4,000 pounds for the four horses, equal to about two tons gross weight. The soil is very heavy, stiff clay; and, according to all the tests of the dynamometer, would readily offer a resistance of 400 pounds to each plow, thus making the entire draught of the machine about 800 pounds. Now, if we deduct from the aggregate weight of the four horses, which we estimate to be about 4,000 pounds, the resistance of the machine of 800 pounds, it leaves 3,200 pounds of horse weight, to be united to their muscular power, for overcoming the weight of the sod.

The estimate of horse-power being, according to Watt's experiments, a power capable of raising 33,000 pounds one foot a minute, it follows that, to raise 800 pounds, the draught of this machine one foot a minute, would require two-eighty-seconds of a horse-power.

We have seen that the machine, in plowing five acres per day of ten hours, moves at the rate of about two miles per hour, or 176 feet a minute. Therefore it would seem to require 176 times two-eighty-seconds of a horsepower to drive this machine two miles an hour, which would be equal to a steam-engine of four and three-fourths horse-power.

Now, if an engine of four and three-fourths horse power could be so constructed as not to weigh more than the weight of the four horses, to wit, 4.000 pounds, or two tons, with a device to obtain a traction resist-

ance of 96 square inches, which we have seen is the traction contact of the four horses, may not the engine, *ceteris paribus*, be capable of accomplishing the same results?

We have seen that none of the engines already constructed and tested, have had any reference whatever to these prominent facts. One relies on great power, but takes no heed of traction. Another furnishes traction without proportionate power, but overloads his machine with superfluous weight.

Before dismissing this most important subject, as regards both the pride and welfare of all Americans, we will quote from a few standard journals, which may naturally be supposed to reflect the popular feeling.

The Scientific American, January 29, 1870, says:

Almost daily, our practice as patent solicitors confirms the views often expressed in these columns, that agriculture, as an art, is undergoing a mechanical revolution. The universal adoption of power machines for cultivating the soil is all that remains to render the revolution complete. The first step in this direction is the attempt which has for some time been in progress, to substitute improved machines driven by horse-power for the operations of seeding, harrowing, and cultivating; which, in the regular routine, succeed the operation of plowing. The machine plow, driven either by steam or horse power, most probably the former, will follow in due time. * * * There is plenty of room for improvement yet in machines already invented; but the most immediate and pressing want is a good, yet not too costly, steam plow.

In the same journal, a correspondent from Wisconsin writes:

I often think, on perusing your journal, that the tendency of the age is to supersede all manual labor by machinery * * We at the West, particularly, need a good, cheap steam plow, that can be made practical for at least the better grade of farmers. The English plan * * of duplex, stationary engines, with the cumbrous "artillery of attachments," may do for sluggish people, but will never meet the wants of the Yankee nation. The steam plow suited to the genius of our people must, to use a vulgarism, "get up and go." It must possess sufficient power of propulsion and traction to pulverize the ground better and deeper than the old way; such is the want of the Great West.

Again, January 22, 1870, this journal, through another correspondent, says:

It is a proposition, confidently asserted and believed by all men of observation, especially those who have given some attention to agricultural engineering, that this country is now ripe for the steam plow. While Great Britain has over 3,000 steam plows successfully at work, on comparatively small farms, we have in the whole extent of the United States but five steam plows in use, four of which have been imported from England, while one is the Standish digger, now being tested in California.*

The American Artisan, January 12, 1870, says:

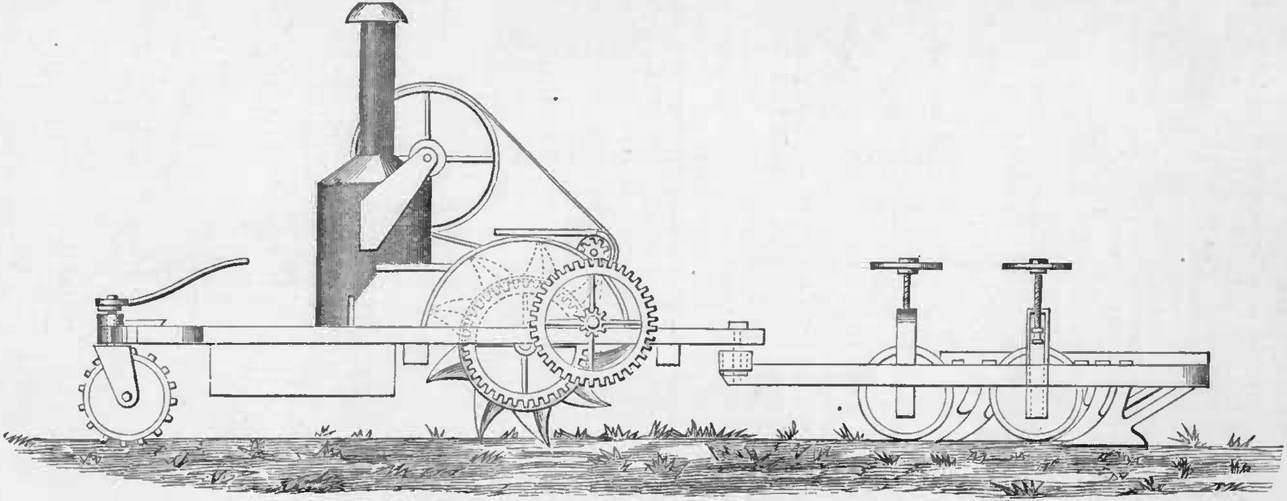
In this country the term "Agricultural Engineering" is hardly understood as applying to a distinct branch of practical science. * * * In England the comparative success of steam plowing has led to a corresponding activity in the production of machinery for other agricultural uses, while frequent and extensive exhibitions (not horse-racing fairs) have excited an emulation and *esprit du corps* among large manufacturers, that have caused the acceptance, by common consent, of a higher standard of workmanship than, in relation to the same subject, has yet obtained with us; and, consequently, to a demand for greater skill and acquirements in the specialty under consideration. * * The immense financial resources of many of the English landed proprietors, and the low rates of wages paid to attendants upon the Fowler machine, made steam plowing in England a success. This result, with the same machinery, has not, and could not, be secured here, with the cheap, arable, and easily available acres; the comparatively moderate means, and the high rates for labor common in our farming communities. * * Instead of a distinct branch of engineering science, devoted to the requirements of farmers, we shall have a system of specialties. * * * This will be the case, at least, until the American steam plow *par excellence*, shall have taken its place in the operations of every-day tillage.

Again, the same journal says:

In what manner, or upon what system, the problem of plowing American farm lands by steam will be finally solved, no one can pretend to say. * * * The diggers,

* These plows were taken to Louisiana, but proved to be of too small power for effectual use in sugar-cane culture, and the engines were employed in steam-mills.—[ED. REP.]

PLATE XXVII.



S. B. WILKINS'S STEAM PLOW.

Patented June 1, 1869.

to which class the California Standish plow belongs, have not, in the practice of the past, equaled the expectations of their projectors; and while we wish the invention all success, we fear a further trial will develop drawbacks to its extended use. The steam plow of the future, judging from present data, will involve the use of rope traction in some form, and if this be so, there will be scope for improvements, not alone in the main features of the machinery, but, also, in some of the adjuncts already in use abroad, and essential to any apparatus dependent upon this principle of operation. * * To speak again of the adjuncts of steam-plowing machinery, we may make brief remark concerning the desirability that some American substitute be found for the English clip-drum, patented in this country, and used upon the two or three Fowler plows thus far introduced here. * * * The adoption of hints given by the best foreign experience, and the substitution, by new devices, of those new essential parts, but practically tabooed to American mechanicians, will make at least a step forward in the realization of *steam tillage* in our fields.

AGRICULTURAL PATENTS OF THE YEAR.

There is no object of more interest in Washington than the United States Patent Office, the repository of all the silent but eloquent memorials of the genius and efforts of our inventors, and there is no department of this vast institution more pleasing to the general visitor than that devoted to agriculture. The models are generally so simple in structure as to suggest their purpose without reflection or conjecture, as many of the more complicated machines do not. The hall containing the agricultural models is about two hundred and seventy feet long, and is provided with sixty cases, (exclusive of those in the galleries,) each case being about twenty-five feet long by five feet wide, and provided with four shelves, upon which the models are arranged as closely as they can be made to stand. Of these sixty cases, thirty-one are devoted to agricultural models, systematically arranged in classes, each class being subdivided into years, and every model bearing a card having the subject of invention, the name and residence of the inventor, and the date of the patent on it.

During the year 1869 nineteen hundred patents were issued, in this department, which may be classified as follows:

Bee-hives, houses, traps, &c	62	Hoes	25
Butter workers, tubs, &c	20	Markers	12
Cattle ties, slaughterers, catchers, &c.; chicken coops, nests, &c	35	Milk coolers, safes, pails, and dairy apparatus	45
Churns and churning	130	Mowing and reaping machines	30
Corn shellers, huskers, &c	40	Planters	150
Cotton gins, pickers, &c	30	Plows and attachments	255
Cultivators	150	Pruning	15
Diggers and spaders	30	Racks	6
Drills	30	Rakes	90
Egg carriers, detectors, &c	8	Rollers	15
Fertilizers	6	Sap spiles	5
Forks—hay, manure, pitch, &c	100	Scythes	5
Fruit boxes, crates, pickers, &c	20	Seeding and sowing machines	80
Garden implements	5	Separators and smut machines	50
Grain bins, granaries, &c	10	Stalk cutters	7
Grain cleaners	20	Straw, hay, and fodder cutters	30
Harrows, drags, pulverizers, &c	80	Thrashing machines	35
Harvesters and attachments	195	Yokes	15
Hay spreaders	25	Miscellaneous	18
Hay tedders	10		1,900
Hedge trimmers, setters, &c	6		

It will be observed that the plow takes front rank in numbers as it does in point of importance. It is of course understood that a patent is not granted on every application, as all inventions are not novel, and it is safe to say that applications for patents for improvements on the plow average one for each day. Notwithstanding this rapid increase, there is apparently as much room for improvement as ever. One of the examiners states that when he first entered the Patent Office, he con-

sidered the field of invention nearly closed, so much had been done that he could see little room for further improvements; but after an experience of nearly seven years he concludes that there is no limit to inventive genius. Though a thousand improvements have been patented, the field is still open; and there are as many applications for improvements now as when there had been but five hundred patents issued.

STEAM PLOWS.

So many magnificent theories in regard to the practicability of plowing by steam have proved fallacious when tested in practice, that inventors appear to rank notions of that character among the utterly impracticable, and consequently to be "let alone." The hauling system, by which is to be understood the mode adopted by Fowler, who employs a stationary engine to draw a plow across the field by means of a long rope, or chain, which winds around a drum or pulley, has been fully and satisfactorily tested in England, but has not been extensively introduced into this country. We need the steam plow however; there is no spot in the whole world so well adapted to plowing on a large scale as the broad prairies of the West. Nowhere is there a finer field for the display of an effective machine; namely, level ground, loose soil, and all the accessories to render success certain and complete.

Of the two hundred and fifty-five patents issued in 1869 for improvements in plows, but five were for steam plows.

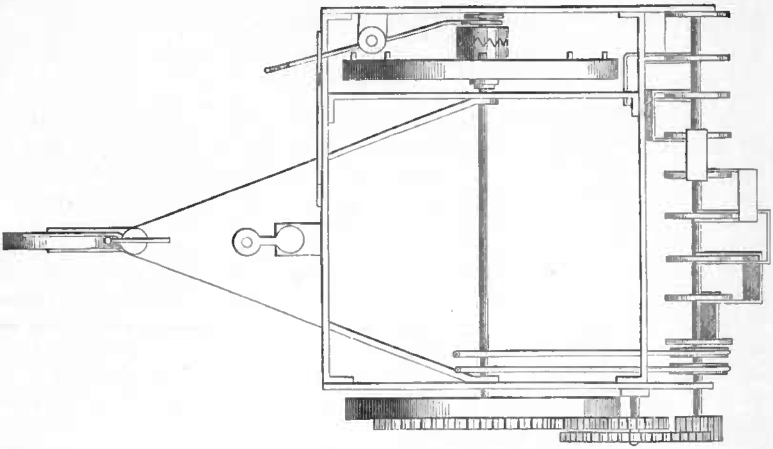
The invention of S. B. Wilkins consists of a gang of plows of ordinary construction, attached to a frame-work, on which is mounted the steam-engine; the traction power, which is the main idea of this invention, being exerted through the medium of a large roller placed beneath the frame-work, and studded with large spikes or teeth of a peculiar structure, intended to enter the soil, and "bite" so securely as to overcome the resistance of the plows.

The invention of James H. Northcott consists of a frame, to the rear end of which is secured a transverse shaft, to which a rotary motion is communicated by the steam-engine with the onward progress of the machine. To this shaft is attached a series of cutters spirally arranged, to prevent too many entering the soil at one time. The shape of these cutters may be illustrated by bending a piece of hoop-iron to form three sides of a square, one edge of the middle part of which is sharpened, thus forming an implement something like that used by merchants for removing names, &c., from barrels and boxes, and popularly known as a scraper.

The invention of Lewis Stewart consists of a frame supported on two broad-track wheels, in the rear of which frame are supported devices which may be called plows. These plows are a series of diggers on radial arms extending out from revolving shafts arranged longitudinally to the machine, so that when the shafts rotate, the diggers revolve and enter the soil at right angles to the line of progress of the machine. These diggers are peculiarly shaped, and appear to be constructed with a view to raising the soil after cutting it, and then depositing the sod in an inverted position on the ground.

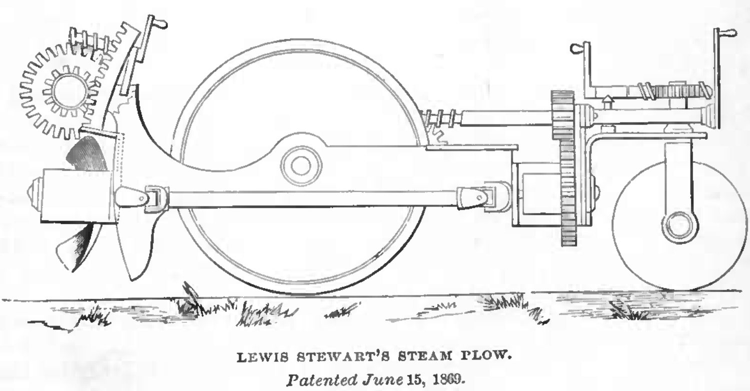
The patent of A. J. Stevens shows a steam-engine mounted on a frame supported in front by two broad-track traction wheels, and in the rear by two rollers placed on a single axle, and extending across the whole width of the frame. On these rollers are placed plows composed of a mold-board and standard, placed in rows of three, the plows in each row breaking joints with those in front. The plow cylinder is rotated

PLATE XXVIII



J. H. NORTHCOTT'S STEAM PLOW

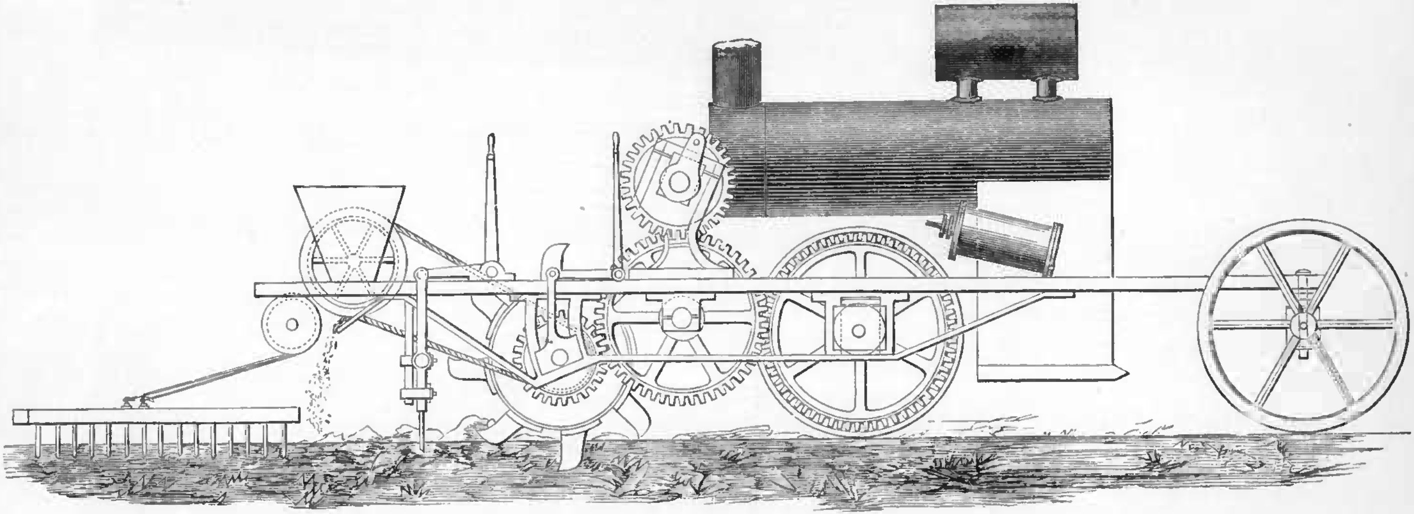
Patented June 22, 1869



LEWIS STEWART'S STEAM PLOW.

Patented June 15, 1869.

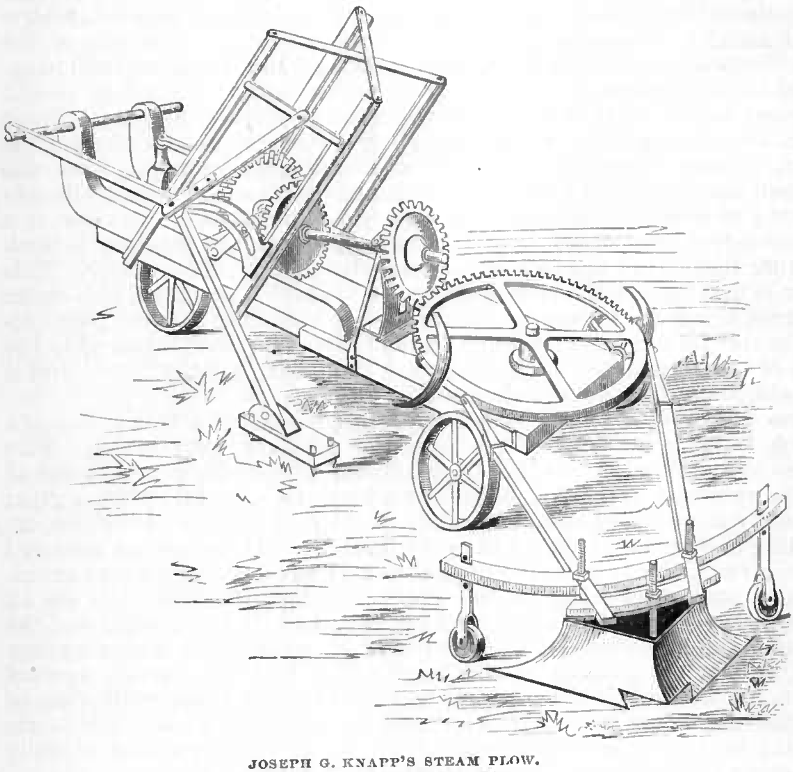
PLATE XXIX.



A. J. STEVENS'S STEAM CULTIVATOR.

Patented August 10, 1869.

PLATE XXX.



JOSEPH G. KNAPP'S STEAM PLOW.
Patented November 30, 1860.

by means of cogged gearing from the traction wheels, and is vertically adjustable, as is also a frame of knives placed some distance in the rear, and designed to comminute the soil finely and prepare it for the immediate reception of seed.

The invention of Joseph G. Knapp consists in so constructing the machine that it and the plows shall be moved alternately, the machine being moved forward intermittently, and the plows moved to and fro in an arc of a circle of the machine. By this means the power of the engine is exerted not on both the frame and plows at once, as in the majority of steam plows, but on the frame first to carry it forward the desired distance, when it stops, and the power is then applied to the plows alone, for the purpose of turning over the soil. Both the mechanism for the propulsion of the machine, and the plowing apparatus, possess considerable novelty. The first consists of two arms, one on each side of the machine, each extending from a reciprocating frame downward and backward to the ground, where they are provided with "claws" on blocks of wood having teeth which enter the soil and prevent slipping. These arms are connected to the reciprocating frames by means of a toggle-joint, so that when the frame is raised the claw is drawn from the ground and deposited a few feet further in advance; the frame still continuing to descend, the machine is propelled forward. The plow is a "double-end mold-board plow," or two plows brought together in such manner that either end can be used without turning the machine. This plow is arranged in the rear of the machine, and is sustained by a series of arms which are moved to and fro in such a manner that the plows describe the arc of a circle through the soil. As the plow is placed in the rear of the frame, the machine always stands on solid ground, and is not obliged to pass over broken soil.

The patent of Townley and Freidrich consists of a frame, beneath which is placed a gang of plows of the ordinary construction. This frame is sustained by broad rollers, and the propulsion is accomplished on the principle embodied in the "walking dolls," which were a great curiosity a few years since. A series of "spring feet" are provided, extending across the whole width of the machine. These feet are attached to longitudinal bars provided at each end with collars fitting over eccentrics in such a way that, as the shafts to which the eccentrics are attached revolve, the feet are brought in contact with the ground and the frame is moved forward. The eccentrics are arranged in such a manner that half of the number of the longitudinal bars are moving upward while the other half are moving downward; and thus, while some of the feet are on the ground and pushing the machine forward, others are moving to a more advanced position to be similarly operated, thereby keeping up a continual forward motion of the machine.

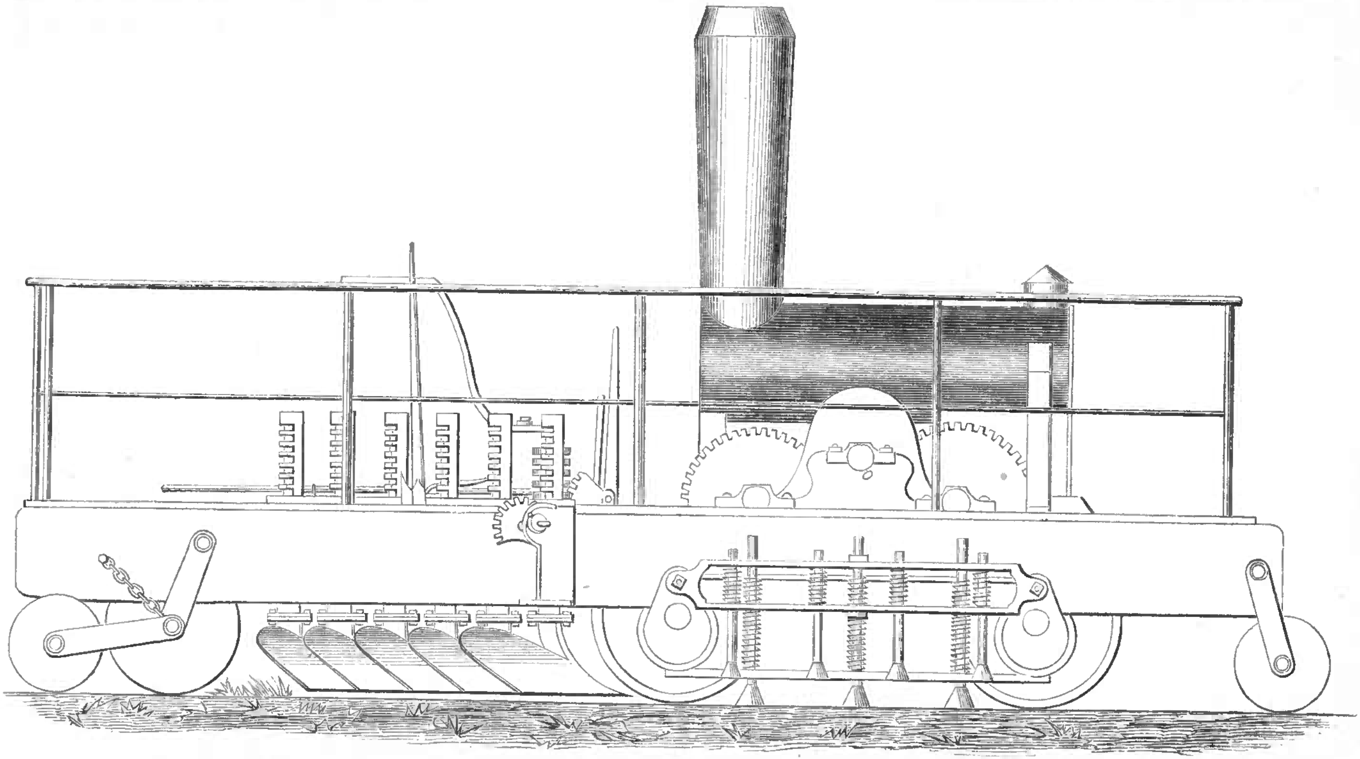
The last invention to which reference will be made under the head of steam plows is that of Augustin L. Taveau, which was entered for patent in 1869, although the patent will bear the date of 1870. This plow belongs to that class in which the machine traverses the field and accomplishes the turning over of the soil simultaneously. It may also be used as a stationary engine working on the Fowler principle, or the locomotive may be run across the field and anchored securely, and the plows drawn up to it. It is claimed, however, that the traction has been so effectively overcome that the machine may be worked in ordinary soils in the manner first suggested. The main point in this connection is the construction of the traction wheels, which are two in number, made broad, and provided with teeth of a peculiar construction, being beveled on the rear side, by which means it is believed they will not

only "bite" the soil forcibly but will leave it readily. These wheels are each provided with a circular disk having a sharp cutting edge, designed to serve the purpose of a colter to the plows, and by which means it is believed by the inventor something like fifty-five per cent. of the traction power of the plows will be overcome. In the rear of the engine is placed the plow frame, on which is arranged a gang of plows constructed to be readily raised and lowered. The standards of the plows are pivoted and provided with brittle pins so that on meeting obstructions the plow will swing back and up, and thus obviate serious damage by breaking or stopping the machine. The plow frame is wheeled and the plows are made without soles, by which means it is believed that bottom friction will be nearly or altogether done away with. In the rear of the plows is arranged, if desired, a modified form of a harrow, which is provided with suitable seed and manure sowing devices. It is intended thus to effect in one passage over the field the several operations of plowing, harrowing, manuring, seeding, and covering; or the plow and harrow may be run over without the seed-sowing devices being brought into operation. For the second trip the plow frame may be detached, and the seed sown and covered by the harrow. The engine may be converted into a land roller, or road locomotive, by covering the wheels in such a manner that they make but one large cylinder, and suitable pulleys are attached for driving any kind of farm or other machinery.

THE DIRECTION OF IMPROVEMENT.

As a rule, the efforts of inventors, with reference to other agricultural implements during the past year, have been mainly directed toward improving the efficiency or correcting the defects of well-known machines. In some few instances radical changes have been attempted. For the reason that improvements are being made step by step, it is difficult to lay down lines of distinction, or to point out what has been done. The improvements made, however, although almost imperceptible when viewed individually, are not on that account to be considered unimportant. In the aggregate we can notice that each link is essential, and that if this or that had been neglected or undiscovered, the golden chain of complete success would not have been made. In some instances, changes are made which, while apparently trifling, entirely obviate some defect in the operation of the machines, make them work more smoothly or rapidly, or with greater power or less waste of material; and thus, while making but little perceptible alteration, greatly multiply the advantages of the inventions. In many cases cheapness is the aim. There is scarcely any work around the farm for the performance of which a machine cannot be found; but many of these are very costly. To construct machines of this character, at reduced prices, or to lessen the cost of others, is a desideratum of no slight importance.

Again, many improvements are intended to cover what might be considered the mechanical structure of the machine. It has been questioned whether a patent should be granted for what may be deemed a mere work-shop expedient, as a superior manner of bracing a frame, and the like; but it is generally allowed that patents of this character stand on as firm ground as those for other improvements. Can it be said that he is a less meritorious inventor who, by the exercise of his faculties, discovers a method of construction by which a machine may be made to last longer, than he who, by a modification of the operative parts of an implement, effects a result more cheaply and rapidly?

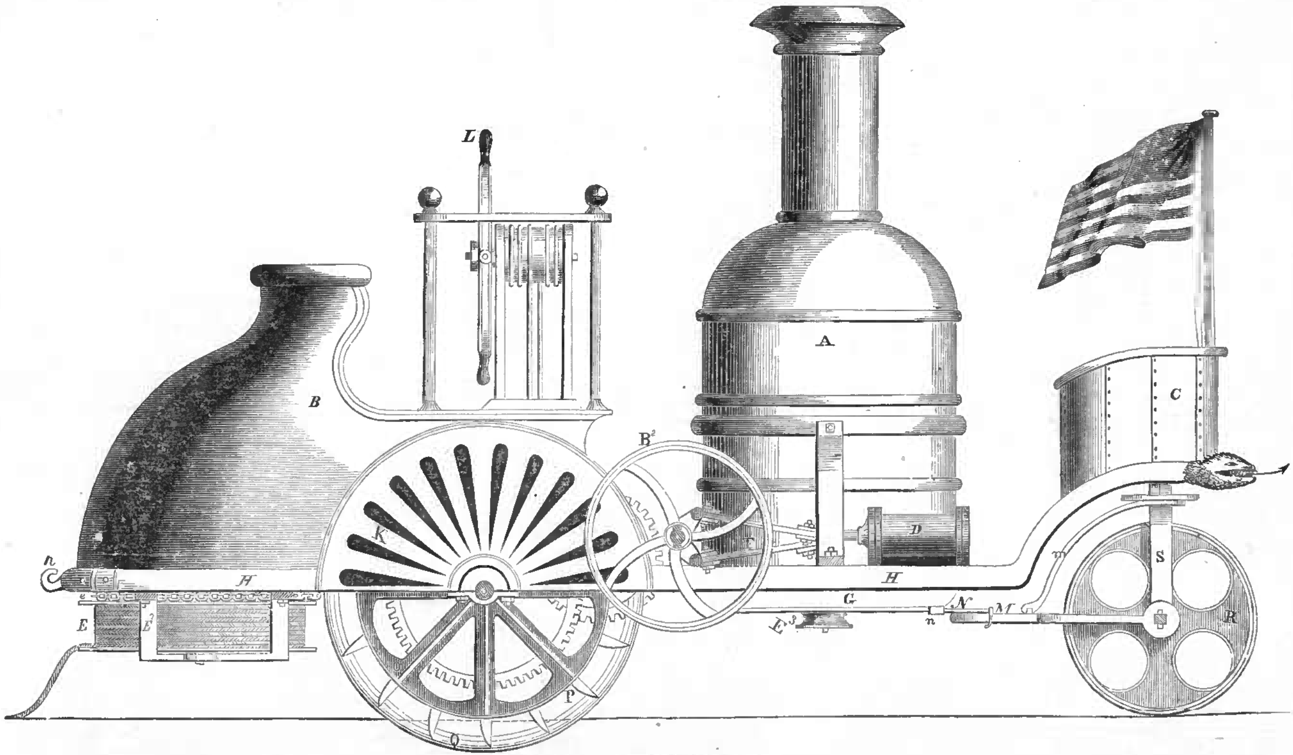


TOWNLEY & FRIEDRICH'S STEAM PLOW.

Patented April 27, 1869.

PLATE XXXI.

PLATE XXXII.



A. L. TAVEAU'S STEAM PLOW.

Entered for patent in 1869.

IMPROVEMENTS OF PLOWS.

The number of improvements on the plow patented during the year is very large. The magnitude of the number is owing, doubtless, to the fact that comparatively few of the inventions patented are ever introduced into public use. The possessor of a well-known form of plow becomes aware of some defect in it, and sets his wits to work to discover a remedy. Having discovered the remedy he obtains a patent, and that is the end of it. Owing to a lack of means, or a want of energy—for it is one thing to perfect a theory in the closet and quite another to bring it into public favor—or for some other reason, his invention is never introduced. A second inventor, unaware of the work of his predecessor, strives to obviate, and does obviate, the defect already overcome, and also applies for a patent. If he is unfortunate enough to have worked out his idea in the same way as did the man who went before him, he is compelled to join the army of rejected applicants for patents; while, if he arrived at the same end by different means, as is generally the case, he obtains the coveted parchment which enables him to make, sell, and use the invention to the exclusion of every other person, and goes on his way rejoicing over his monopoly.

In the matter of swing plows, it can scarcely be said that any decided and unusual stride has been made during the year; nor has any strikingly unique form of mold-board, landside, standard, brace, colter, or clevis been patented in that period. Applications have been chiefly for improvements in those devices.

Quite a competition has sprung up in an attachment of plows known as a "fender," which, although invented years ago, has received until recently but little attention. While the position of the fender is about the same in all plows to which it is applied, viz: pendent from the beam, and slightly in advance of and removed from the mold-board, its purposes differ according to the style of the plow with which it is employed. Thus, on a breaking plow, one intended for raising and turning over the unbroken sod, it is used for bending the weeds and other trash away from the mold-board when likely to interfere with the plowing, or being down in such a way as to fall beneath the ridge of soil turned over by the plow. The fender is also used on cultivators, for the purpose of protecting the growing corn and preventing the heavy clods from falling on the young plants.

The majority of plows patented are those known as swing plows, by which is to be understood a plow unsupported by wheels, and the chief aim of the inventors has been, while otherwise improving their efficiency for general and specific purposes, to make them lighter and cheaper. In this respect our American inventors have good reason to boast over their competitors in other lands, as may be readily appreciated by a comparison with foreign implements of our light and jaunty-looking plows.

There is a strong tendency toward wheel plows, "gang" and "sulky," in the prairie country west. By "wheel plows," are meant those in which the plows are carried between a frame supported on two wheels and having a seat for the driver. There seems to be no diminution of interest in this class of plows in any section where they have been introduced.

The points to which attention has been directed by inventors of wheeled plows are various. They have mostly reference to the frame and its appurtenances, and rarely concern the construction of the mold-board, or parts which have to deal directly with opening the furrow. Either lateral or vertical adjustability has generally been kept in view, while much

has been done with reference to a diminution of the draught, and for a construction that will keep the plow in the ground firmly and uniformly, while permitting it to be readily raised above the surface.

It is worthy of note that the patents granted on wheel plows, in 1869, to residents of California and Oregon, largely exceed in number those granted for inventions of a like character from all the other States of the Union.

CULTIVATORS.

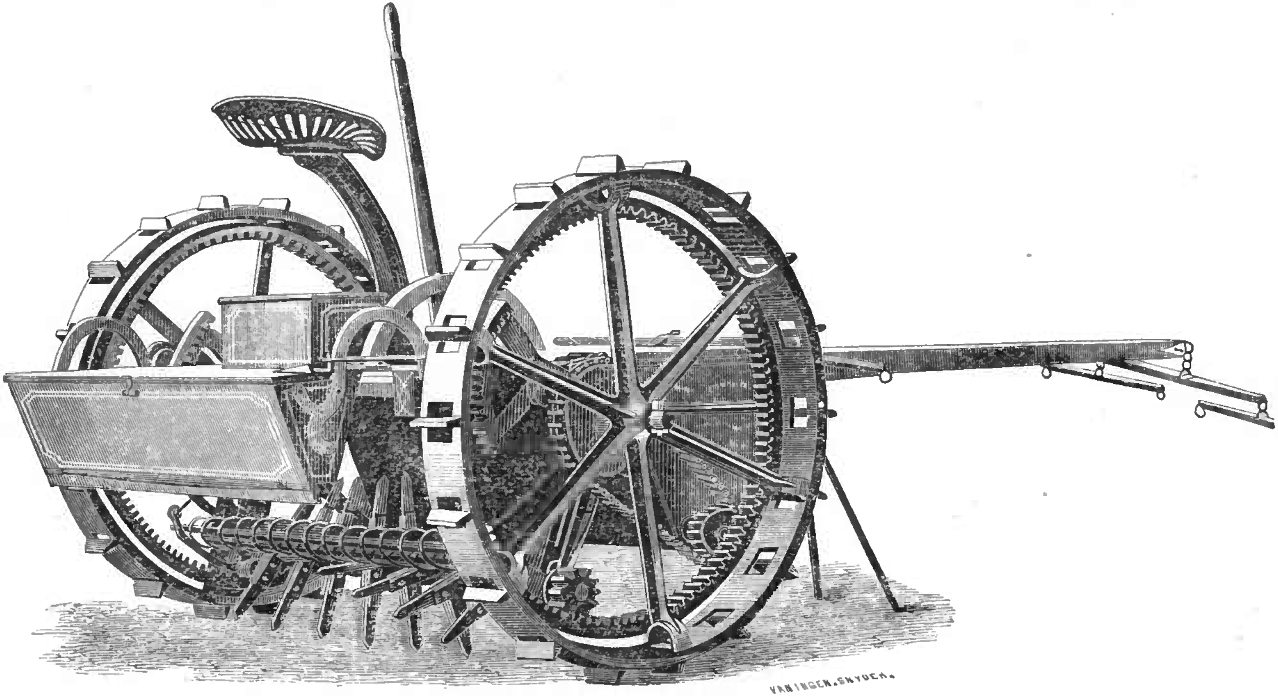
Little or no change has taken place in the manner of constructing cultivators. It is a matter of surprise that out of the one hundred and fifty inventions patented there should be scarcely one that for characteristic individuality merits especial mention. Inventors of this class of implements seem to be pretty well satisfied with the general construction already established, viz: a rectangular frame mounted on two wheels and provided with a tongue and driver's seat, having swinging longitudinal beams, to which are rigidly attached standards bearing shovels or teeth, and they content themselves with improving the details. For this reason most of the claims granted on cultivators (and patents on these machines generally embrace a long string of claims) are what are technically known as "combination claims," *i. e.*, claims on which the patentee disclaims the invention of the individual devices enumerated, but asserts that he is the first one to have brought them all together in the manner specified.

It is difficult to decide whether or not the tendency has been toward greater simplicity in cultivators. Some inventors seem to have aimed at that result and to have hit the mark, while others appear to have overlooked the idea altogether. This remark is intended only with reference to a comparison of a few recent years, for certainly when compared with similar inventions of twenty years ago the complexity is all on the side of the more modern productions. Indeed this is a safe general expression with regard to inventions of every character. The tendency of inventions at the present day is twofold, viz: to make each machine as nearly automatic as possible, and to combine in one structure the devices necessary for several purposes. These necessarily make machinery more cumbrous. It is not an exceptional thing to see combined with a cultivator apparatus designed for several different purposes; as a breaking plow, a corn marker, a seed planter, a stock chopper, or a harrow.

In cultivators considerable attention has been devoted to obtaining a ready and efficient expansibility and contraction of the beams so as to admit of the adaptation of the same to the width of the rows cultivated. Successful attempts have been made to improve the shape of the teeth, that their cutting edges may act more efficiently, and to improve their adjustability so as to throw the soil more or less to right or left, all one way or the other, when in gangs, and to adjust their positions where more than one is used. Considerable intelligent labor has also been bestowed on constructing the teeth so as to admit of their ready removal when worn out, or when, from any cause, it is desirable to detach them.

Several cultivators have been patented especially devised for the cultivation of cotton and sugar, and which will be likely, in view of the past want in those directions, to prove valuable, and consequently to go into general use.

As in the case of plows, the tendency is decidedly in favor of wheel cultivators. Now and then a "walking cultivator," *i. e.*, one in which



A. L. TAVEAU'S REVOLVING HARROW.

PLATE XXXIII.

there is no seat or other provision for the driver or operator who is constantly compelled to walk, is noted; but they are uncommon.

HARROWS.

Perhaps in no other class of tilling implements, except steam plows, have there been proportionately so many radically unique inventions as in harrows. The first one to which attention is directed consists of a rectangular frame provided with a series of spring teeth. These teeth are not straight, as in the ordinary drag, but are curved nearly like the teeth of a horse hay-fork, their curve rising above the beams to which they are attached.

The second invention consists of a large and heavy rectangular beam to which is secured a series of iron rings with teeth projecting to the front and rear, the former being designed to prevent the passage over the beam of any clods, and the latter to effect a complete pulverization of the soil already somewhat disintegrated by the action of the iron-shod beam.

The third invention involves the principle embraced in the harrow of F. Nishwitz, (illustrated in the Agricultural Report for 1866, page 250,) having a frame in which is situated a series of concave disks arranged obliquely to the line of draught, and which, it is claimed, have the effect of finely comminuting the soil. These disks are provided with scrapers, which remove the adhering earth and prevent any accumulation.

There have been but few rotary harrows patented during the year, and none in which a new principle of automatic rotation has been developed. Those patented exhibit the three well-known methods which proceed upon the theory of making the traction greater on one side than on the other, viz: the weighted bar for pressing down one side more deeply than the other; the oblique spindle, or central shaft, upon which the harrow rotates for the same purpose as the weighted bar, and the arrangement of the teeth in such a manner that those on one side of the harrow shall point forward, while those on the other side point to the rear, thus producing a greater traction on the former than on the latter, and a consequent rotation. The great defect in the automatic rotary harrow is, that it scratches the soil more deeply on one side than upon the other, and consequently, where uniformity is desired, the same ground has to be gone over twice. This has been remedied by duplicating the harrows, that is, by arranging two harrows together, one dipping to the right and the other to the left, the contiguous arms of both meshing in such a way that the soil between is acted upon thoroughly. There is no automatic single rotary harrow, however, in which this defect does not exist, and it is apparently irremediable.

The majority of harrows patented during the year are of the "flexible" sort, those in which the frame is so made that, while the several parts are constructed of rigid material, they are arranged to adapt themselves to the inequalities of the surface. In some cases this is secured by jointing several beams together by means of links, so that each beam may rise and fall independently of the other; in other cases the result is attained by dividing the whole harrow into two or more subsidiary frames, which are hinged together in such a way that either division may rise or fall without affecting the operation of the other. This latter scheme is generally accomplished by making the harrow triangular in form, with a beam running from the apex of the figure to a point coincident with the middle of the base. This beam is either made single with the sides, or wings, hinged to it, or double, the two parts being joined by a hinge connection. In both cases either side of the harrow

may be elevated or depressed independently of the other side, and by this construction the operator is enabled to raise a part of the harrow to clear a stone or other obstruction, or to remove any accumulation of "trash" without disturbing the operation of the remainder.

Only one patent was taken out during the year of the class known as "chain" harrows, *i. e.*, composed entirely of iron chains, no beams whatever being employed; and this invention differs but slightly, if at all, from those well known in England, but which seem to meet with little favor or attention in the United States.

Several patents have been granted in which is shown a construction that, although not novel in principle, is worthy of remark—as that of harrows in which the teeth are so arranged that, while the work is going on, they are in a vertical position, but which may be manipulated to assume an oblique position slanting to the rear, whereby accumulated weeds, branches, &c., may be dropped, and rocks or other obstructions passed over with greater ease and less danger of breaking the teeth. This is generally accomplished by constructing a rectangular frame with parallel beams for the teeth, which beams are arranged transversely to the line of draught, and are journaled into the side-pieces of the frame in such manner that they will partially revolve on removing a spring or other device provided to keep the teeth in a vertical position.

A few of the patents granted are for wheel-harrows; those in which a sulky frame is provided, to which the harrow is attached in such a manner that it may be elevated to clear obstructions or for removal from the field. In two cases sled-runners are affixed to the top or back of the harrow frame so that by turning the same over it is converted into a sled. One of these sled-harrows is made in three parts, and so arranged that the side-pieces can be folded up over the center, covering the teeth and thus preventing the discomfort otherwise attendant upon a ride on such vehicle.

Before dismissing this subject of harrows, a brief notice will be bestowed on an invention which, although classed with that division, and intended in part for effecting the pulverization of the soil, is adapted to other purposes. In the invention referred to there is provided a two-wheeled frame, upon which are placed hoppers for grain, guano, and grass seed. In the rear of the traction wheels, so arranged by pendants that it may be readily raised and lowered, is the harrow. This harrow belongs to the revolving class, and is composed of a cylinder provided with teeth spirally arranged and connected to the cylinder by joints and "brittle pins," *i. e.*, little wooden pins, so that when an obstruction is met with the teeth will yield, and thus prevent serious damage. This cylinder is arranged to be rapidly revolved from the driving-wheel, and it is claimed will perform its work very efficiently. This machine, slightly modified, has been adapted to work with a steam plow since invented, and which we have illustrated by diagram and description.

SOWING MACHINES.

Considerable activity has been manifested during the year in machines for sowing seeds and fertilizers. This class of planting machines may be considered under four divisions: 1. Machines for sowing wheat and like grains; 2. Corn or maize planters; 3. Cotton planters; 4. Machines for sowing fertilizers.

SEED PLANTERS.

The first-mentioned class is divided into "drills" and "broadcast seeders," of which the drills are by far the most numerous. Indeed, a

broadcast seeder may be considered an exceptional thing among new inventions.

In a few instances successful attempts have been made to construct a machine which may be converted at will into a drill or broadcast seeder. This is done by providing a single hopper, beneath which is situated a system of drill teeth and a distributing apron or other device for sowing broadcast. Then, by means of suitable mechanism, as an oscillating carrier, the grain is directed into the drill tubes, or on the broadcast distributor, as may be desired.

There are three methods usually employed in grain drills for discharging the seed from the hopper, viz: by means of a reciprocating seed slide, provided with openings into which the grain drops, and by which it is carried over another opening in a lower slide, through which it drops to the ground; a circular plate, provided with seed apertures, and which operates like the reciprocating slide in all save that the latter has a to-and-fro motion while the former rotates; and the revolving cylinder, provided with cells or pockets into which the seed drops, and by which it is conveyed to the tubes through which it is deposited in the earth. Of the three, the last-mentioned is decidedly the favorite. The other methods named, together with two or three exceptional styles of grain deliverers, appear to be pretty generally discarded.

The revolving cylinder is in general constructed of iron, and made so as to admit of the contraction and expansion of the size of the pockets, by which means a larger or smaller amount of grain may be sown. The method of constructing these cylinders generally adopted may be illustrated by placing two hands, palms downward, on a table, the fingers of each being alternated with those of the other hand, so that the second finger of the right hand will be between the first and second finger of the left hand, and so on. Now, by sliding either hand in and out it will be seen that the opening between every two fingers of each hand is contracted and enlarged. As in machines of this character there is a great liability to crack the grain and thus render it useless for planting, considerable effort has been made to remedy this defect. The point at which the grain is generally cracked is where it comes in contact with the bottom of the hopper, and while in the seed cells of the cylinder.

Much also has been done in the matter of flukes, when compared with the advance made in other individual years, the apparent aim of inventors in this respect being to arrive at such a construction as will permit the flukes to be all moved into a single line, or alternated back and forth. The flukes of grain drills are generally arranged in two ranks, one in advance, and the other slightly in the rear, the former being in the line of the spaces between the latter, and not directly in front of it. Several patents have been granted in which by a single motion of the operator the flukes may all be brought into a single row.

CORN PLANTERS.

While there has been no diminution of interest in the matter of corn planters, the points of novelty or difference are so slight that it is not deemed important to specify them. The reciprocating slide, similar to that described in seed drills, and used in connection with a "cut-off," or brush for sweeping back the grain, is generally employed, very often in connection with a hinged valve in the runner, which receives the charge of grain after it falls through the slide, and by which it is dropped into the earth. The cut-off chiefly employed is a brush, although an India-

rubber sweep is sometimes used. Generally one or two scrapers to throw the loose earth upon the dropped grain, and a roller to press the same down, are placed in the rear of the runners.

In view of the increased activity in machines adapted to use in the South, considerable attention has been directed, and with very happy results, to constructing corn planters in such a way as to be readily adapted to planting cotton seed. Owing to the tenacious character of cotton seed, which, on account of the lint with which it is covered, has a tendency to form in balls and "choke" the machine, an ordinary corn planter is not adapted to planting cotton seed. By the addition of a "stirrer," which is intended to keep the seed in the hopper in a state of agitation, and thus to prevent "choking" and cause a free flow of seed, the one machine is made to serve the two purposes of a cotton and a corn planter. The style of stirrer generally employed is a horizontal shaft, provided with spikes or arms, which is made to revolve from the axle of the traction wheel by a pulley band or other suitable gearing. Sometimes a series of circular saws is substituted for the spikes.

Devices similar in character and construction are employed in fertilizing machines, quite a number of which were patented during the year, although none of them appear to be decidedly different from the inventions of previous years.

Among the novel machines patented during the year was one for planting potatoes, which not only deposits the tubers in the ground, but previously cuts them in pieces, the design being to obviate the supposed waste of employing a whole potato with several eyes.

HAND PLANTERS.

In this interesting branch of invention the zeal heretofore exhibited has not been permitted to flag. Fifteen years ago there were but four patented hand planters; to-day there are over a hundred. During this period our inventors have been active, while those of Great Britain have been idling; and, it is stated, there have not been a half dozen hand planters patented in England within two centuries. Our inventors have generally followed two well-known styles of hand planters. The first and most favored is that exhibited in the patent of D. W. Hughes, which patent has just expired, and is therefore public property. In this invention there are provided two legs, pivoted together like the divisions of a candle-snuffer, the lower end or point of which is intended to be thrust into the ground to form an opening for the seed, the upper end being provided with a pair of handles. To the outside of one of the legs is securely affixed a seed box, into which extends a seed slide, which is connected to the other leg. In operation, the lower end of the planter is thrust into the ground; the handles are then brought together, which enlarges the opening in the soil, and at the same time draws out the seed slide, and with it a charge of grain, which drops into the opening. The planter is then withdrawn, and the seed covered with soil thrown upon it, and pressed down by the foot of the operator.

The other implement is what may be termed the "plunger" planter. It consists of a dibbler, to which is attached a seed box about two-thirds the distance from the top, and a valve secured at the bottom, this valve being so constructed as to be adapted to make a hole or seed opening in the soil. Through the seed box runs a slide provided with a cell for grain, and with a handle extending upward and within reach for convenient operation. In planting, the slide is drawn up and a charge is thereby drawn from the box and dropped into the valve. The planter

is then plunged into the ground, and the slide moved downward, its lower end opening the valve and discharging the grain from it.

LAND ROLLERS.

The improvements in land rollers chiefly have reference to an arrangement of several rollers in one frame, usually three, two in front and one in the rear, breaking joints with them, and to means for raising this third roller, so as to admit of easy and short turns. Several patents of this character have been granted. Among those patented during the year are a few in which a construction is aimed at that will enable each roller, where more than one is employed, to adapt itself to the inequalities of the surface of the soil, without interfering with the operation of the others. There is, however, no method more simple or more efficacious than that exhibited years ago in a patent, and which shows a main frame having two subsidiary frames pivoted in it by front and rear pivots, so as to rock independently of one another, each of these subsidiary frames holding a single roller.

POTATO DIGGERS.

The number of patents granted during the year on potato diggers shows that the zeal of inventors with reference to these machines is unabated. It is questionable whether a really effective machine for digging potatoes has ever been brought before the public; that there have been very many which are utterly worthless is certain. The large majority of these inventions are cumbrous and too complicated to be efficient. It will do well enough to multiply wheels and springs, ratchets and pawls, when these are to be employed in shops and places where there will be no extraneous hinderance to the operation of the machinery, but when it comes to adorning with these appliances a potato digger which has to deal with the insidious soil, penetrating into every crack and crevice, the fewer of these devices the better the result.

Many of the inventors of potato diggers have put their theoretical ideas into such shape that a person who wants to see the model of a machine calculated to clear the vines, remove the earth, raise the potatoes, sift them clean, separate the large from the small and deposit each sort snugly into different baskets, can have his curiosity gratified by inspecting the cases of the United States Patent Office.

The potato diggers patented are generally a modification of a structure like the following: A rectangular frame mounted on two wheels and provided with a tongue, with a vertically adjustable scoop or shovel, affixed by suitable pendants or hangers, which is designed to pass under the hill, carrying the earth and potatoes back to a shaker, where they are separated, the earth dropping, and the potatoes are carried to a screen, where they are more thoroughly cleaned. The shaker is often a revolving apron, but more frequently a series of bars or rods which are occasionally jointed or hinged in such a way as to admit of a "jumping," or vibratory, motion. Occasionally one or more revolving shafts are placed beneath the shaker, such shafts being provided with spurs or teeth passing up between the rods, the more effectually to disintegrate and remove the adhering soil.

During the year there were two inventions in this line patented, which differ radically from those patented in any previous year, and which promise great effectiveness. The first is provided with wheels, tongue, and frame as above described. To the tongue, about at the juncture

with the whiffletree, there is secured a shovel plow, which is intended to remove the soil from the top of the potatoes. Just in the rear of this plow, one on each side of the line of the tongue, are placed two rollers, whose longitudinal axes are parallel with the direction of the draught, and which consequently revolve transverseiy to the track of the machine. These rollers are revolved by suitable gearing from the traction wheels and are provided with curved teeth, spirally arranged, which enter the soil, raising and cleaning the potatoes. The other machine has for the digging and cleaning parts two concave disks arranged at an angle of about 45°, and which are perforated or slatted to permit the passage of the earth, the potatoes being delivered in a single line at the rear of the machine and directly in the opened ridge.

HARVESTERS.

In the department of harvesters the inventions patented are directed exclusively to the improvement of standard machines. The beginning of the year found reaping and mowing machines with numerous defects, the chief of which were faulty gathering and delivering devices. Many of the machines belonging to this class require, besides the driver, a man or boy to rake up the cut grain in suitable bundles and discharge it from the platform. Much has been done toward dispensing with this attendant, and making the machine automatic. In performing the operation of gathering, the revolving rake is generally and successfully employed. The defect in the delivery arrangement is this: the grain has been discharged directly in the rear of the machine or upon that portion of the ground occupied by the grain just cut, so that the horses in making their next circuit will tramp upon it if it is not bound and removed. To obviate this a number of patents have been granted during the past year in which are employed automatic binders, designed to secure the cut grain in sheaves, which are deposited on the ground at a point out of the way of the horses.

The tendency of improvements in harvesting machines is to make them lighter and cheaper, the latter desideratum being often obtained at a sacrifice of substantiality in the structure. It is matter of remark how much power is employed in a harvesting machine to effect a small amount of work. It is obvious that to cut a swath of grain requires no greater strength than that in a man's arm, and yet to accomplish it, two to four horses are generally employed. This point has not been overlooked, and efforts have been made to mitigate the evil.

It is esteemed a desideratum to have one machine adaptable to the cutting of both grass and grain. To accomplish this result efforts have been directed to producing a change of motion, as to cut grass a greater rapidity of the cutting instrument is required than in cutting grain. The common method is that in which a sliding pinion or spur wheel is employed, so that by a change from a large to a small gear, or *vice versa*, the speed of the cutter may be increased or diminished.

Of the devices used directly to cut the grain, including the endless toothed belt, the rotary saw, and the reciprocating cutter-bar, the latter retains by far the larger number of admirers. Outside of the fact that inventors would naturally endeavor to evade the patent on this device, and to procure some other instrumentality that, without infringing it, would effect the same result, effort has been making to avoid, by some means, the noise, shaking motion, and jar caused by the rapid working of these machines, as prejudicial to the nerves of the operators as to the durability of the implements. The other devices named, the belt

and the rotary saw, are not so obnoxious to the charge, but they do not meet with the favor which is lavished on the reciprocating cutter-bar. To obviate this shaking and noise, an inventor some years ago obtained a patent for a divided cutter-bar, but arranged the dead-centers of the cranks to which the cutters are connected at right angles to one another, thereby just doubling the evil. It is obvious, however, that this invention may be turned to advantage by arranging the dead-centers in a line, whereby the shock of one side will be met and counteracted by that of the other, and thus produce a smoothly-running and almost noiseless machine for harvesting operations.

HAY TEDDERS AND MAKERS.

Considerable activity is noted in hay-tedding machines, and, as will be observed, the number of patents taken out during the year therefor is significant.

HORSE HAY RAKES.

There has been no diminution of interest with regard to horse hay rakes, although the inventions during the year have been confined to the standard and well-known styles long since adopted, viz: the wire-spring tooth-rake and the revolving or trip rake. Of these the spring tooth-rake is the decided favorite and will be likely to remain so, as it is lighter and much more readily manipulated than the other rake mentioned. Many of the improvements on the spring tooth-rake have been directed toward making it more nearly automatic in its operations, and the efforts appear to have been successful.

BINDING MACHINES.

Much attention has been given to securing a perfect binding machine, and, although the task is one of considerable magnitude, the results have proved favorable. One of the inventions patented during the year, and which is not only simple but effective, is designed for use on a harvester, and consists of an inclined platform upon which the cut grain falls and remains until a sufficient quantity has accumulated, when, by a motion of the foot of the operator, two pins projecting from the lower edge of the platform, and by which the grain is prevented from sliding off, are withdrawn, and the straw permitted to fall into a trough. As soon as the straw falls into the trough, two curved metal arms, which work in slots in the side, move down upon and compress the bundle, around which a band is quickly passed, thus completing the operation.

HORSE HAY FORKS.

In these implements there has been no radical departure from the three established forms, viz: the double and single hook and the expanding harpoon fork. In each the distinctive features have been preserved, the design generally being to make the forks more nearly automatic in operation.

Within the past few years a class of implements closely allied to the foregoing, and known as manure forks, has sprung into existence. They consist of beam and handle like an ordinary plow, the place of the shovel being supplied by a rake head arranged to gather the manure as the fork is drawn through the yard, and to drop it by a backward motion of the rake when the end of the yard is reached, or when the fork

is elevated into a wagon. The majority of those patented exhibit this construction, and most of them, if not all, have been invented in or near Lancaster, Pennsylvania.

Although the number of patents granted on hay-loaders is small, sufficient has been done to furnish efficient means for loading, and the farmer of the present era may avail himself of machinery that will handle his crop by successive steps all the way from cutting the standing grain to loading the same into the stack or barn.

THRASHING AND WINNOWING MACHINES.

There has been no abatement of interest in thrashing and winnowing machines, but the departures from the usual styles of construction are rare.

In the thrasher the spiked cylinder is generally employed, although there have been several patents obtained during the year in which a different device is employed for the same purpose. This device is a system of rotating flails or beaters, to which the head only of the sheaf is presented, by which means the grain is separated from the straw without bruising the latter.

In winnowing machines the changes have been slight, the hopper, shaking screens, and fans being generally preserved, and the improvements limited to perfecting the different elements named. There is one invention in this class, patented during the year, which deserves particular mention, as in it the weight of the grain is utilized. The material to be cleansed is placed in a hopper, from which it falls upon the wings of a fan, arranged and operating like an overshot water-wheel, by which means the devices necessary for cleaning are put in motion.

In both winnowing and thrashing machines a considerable number of patents has been obtained for devices for regulating the blast from the fan, which is sometimes so strong as to blow the grain off the riddle. These devices have in view an automatic arrangement of the entrance passage for air, whereby, when the machinery moves rapidly, the size of the passage is decreased and the quantity of air admitted thus diminished, the operation being analogous to that of the governor of a steam-engine, although the appliances nowhere resemble it. The theory of operation observed in several of these is this: The blast from the fan is directed against a flap, which communicates, by means of a lever, with a valve on the air opening. When the blast is moderate the valve, which is weighted, remains open; but when the blast becomes violent, owing to the rapid motion of the fan, the flap is moved, and the lever connection closes the valve wholly or in part. As the machinery moves more slowly the force on the flap is withdrawn, and the valve opens automatically by reason of the weight.

CORN HUSKERS AND SHELLERS.

Considerable activity is noted in improvements in corn huskers and shellers, the greater stride having been made in the former. There have been numerous patents granted for "hand" huskers, but they generally consist of a small and simple implement designed to be grasped with one hand and to assist in tearing the husk from the ear. These hand huskers are sometimes a sort of glove provided with teeth or hooks; sometimes a device to be used like a pair of tongs, having two pivoted arms between which the husk is caught; and often consist simply of a little metal bar provided with loops or rings for the fingers, and a projection,

between which and the thumb the husk is seized. These hand-huskers are not of much importance, as their main object is to save the hand of the operator, without expediting the work greatly. Indeed, it is a matter of doubt whether with the aid of any one of them a man could husk more corn per hour than with the old-fashioned husking pin. They ought not, however, to be entirely disregarded, as they slightly facilitate the husking and save the fingers to a considerable degree.

The machine huskers are of more importance, however, although there has not been an invention patented during the year which exhibits strictly a new principle. Still the improvements made are gratifying. The style of machine husker generally employed is that embracing a pair of corrugated horizontal rollers, with yielding bearings, the province of these rollers being to "bite" off the ear from the stalk which is presented to and drawn between them, the ear falling upon or being carried to the stripping rollers. The stripping rollers are generally arranged transversely to the horizontal rollers and in a slanting position, so that the ear, when stripped of its husk and silk, may slide down into any suitable receptacle. These rollers are placed close to one another, and nip or catch hold of the husk and tear it from the ear in a very rapid and satisfactory manner. The stripping rollers are generally covered with some elastic substance, as India-rubber, and have spiral grooves or corrugations. In some cases hard rollers are employed, and they may be grooved or corrugated, or one of them may be provided with teeth moving through annular grooves on the other rollers.

In corn shellers the improvements have not taken a very wide range. The disk sheller is pretty generally discarded, and the improvements are confined mostly to the cylinder sheller and to the form of sheller having the devices originally shown in the patent of Houseman. This sheller is a hand implement, and, in its improved state, is composed of two iron bars about six inches in length, pivoted together, the shelling ends or palms, which are semicircular in form, being kept in close contact by means of a suitable spring. The palms are made semicircular in form so as to embrace the ear, and their inner sides bear ridges or ribs terminating in claws, which serve to remove the kernels, the ribs having a spiral inclination which serves to draw the ear through when the implement is operated. In operating it the sheller is seized by a handle provided for that purpose, and the small end of the cob inserted between the palms. The instrument is then revolved and the ear drawn through, the kernels being easily and quickly removed by the claws. The improvements made are valuable, but are mostly or altogether confined to variations upon the machine named.

GRAIN BINS.

There has been a noticeable movement in the direction of grain bins, but the improvements have had reference chiefly to bins intended for use in our great grain marts, as Chicago, where immense quantities are stored. These bins are frequently constructed of some porous material, generally bricks, intended to absorb any superfluous moisture, and thus prevent the grain from spoiling. The bins are generally made of circular form, and are arranged in series, side by side, in a manner intended to economize space as much as possible. In grain dryers the inventors seem to have mostly in view the drying of the grain by the introduction of currents of air. These currents are generally introduced through perforated pipes which run through the bins; sometimes perforated partitions or walls are employed for a similar purpose.

COTTON GINS.

The return of peace, and the consequent increased attention to the culture of the great southern staple, have caused marked activity in the department of cotton gins.

On account of the present efficiency of the McCarthy gin, the subject in England of at least a hundred patents, or on account of the laudable desire of our inventors to produce a machine which will perform more work in the same time, there has not been a single improvement patented on this gin during the past year. This gin, otherwise known as the roller gin, is composed of two cylinders revolving toward each other and provided with a fixed blade which bears against the upper cylinder just above the point where the cotton is presented, and a reciprocating blade which, in its downward motion, strikes against and removes the seeds from the cotton fiber, the cotton being drawn in a cleaned condition through the rollers. This style of gin is employed to gin Sea Island or long-fiber cotton exclusively; but while it works well it moves slowly. The saw-gin, on the contrary, which is employed for the common or short fiber, is, in its ordinary form, totally unsuited for Sea Island cotton. The rapidity of its operation, however, has attracted the attention of several inventors, and efforts have been made to adapt it to ginning Sea Island cotton. It is obvious that any improvement which would effect this result would be of great importance, as it would materially reduce the price of long-fiber cotton, of which only about forty pounds per day can be ginned by the ordinary roller-gin, while a saw-gin, if effective, could gin five times that quantity.

Of the improvements made in this direction two have reference to the saw and one to the rib. Those of the former character consist, first, in substituting for every alternate saw a disk without teeth, thus widening the distance between the saws and preventing the tearing of the fiber, which is at the same time supported by the disks; and, secondly, in constructing each saw with blank places at intervals of, say, every six teeth, the area of blank spaces being about equal to that occupied by the teeth. The improvement on the rib consists in constructing the same with a ridge on the hopper side of the ribs, which ridge serves to hold the fiber while being acted upon by the saws and to prevent them from taking hold of it at too short intervals, whereby breaking is apt to take place.

Several patents have been taken out on what may be called the saw-roller gin, comprising, as it does, many of the features and advantages of both the saw and roller gin. In this machine there is provided a large cylinder, which may have saws, but which is generally covered with a serrated wire arranged spirally. Between every two circles of this serrated wire is placed a packing of some description, generally metal. Above this cylinder, and revolving in the same direction, is placed a small corrugated or fluted stripping roller, which strikes back and removes the seed, &c., its operation being assisted by a horizontally reciprocating bar with a plain or serrated edge.

A patent was granted during the year for an improvement intended to adapt the ordinary saw-gin to cleaning cotton seeds. It is known that the ordinary gin turns out the seed covered with lint to such an extent that a ton of the seeds will sometimes have as much as eighty pounds of cotton adhering to them. Nor is this loss of cotton the most objectionable feature, for seeds thus covered with lint have a tendency to clog in planting, rendering that operation difficult. The improvement referred to, and it is the only patent issued during the year for the

purpose, consists of a longitudinally grooved roller placed in the hopper in front of the saws, and which serves to keep the seeds in a state of continual agitation, every side of each being presented to the saws, which completely remove all the adhering lint.

An ingenious English patentee some years ago proposed to remove this lint by passing the seeds over a flame, and employed an endless-apron of wire cloth for that purpose, while an American inventor, at a later period, claimed to have discovered an equally efficacious remedy, namely, the application of gunpowder sprinkled among the seeds in sufficient quantity and then fired. As the "sufficient quantity" is the all-important question in the process, it will be well to make sure of it before experimenting, as an overcharge might remove the seeds as well as the lint.

STRAW-CUTTERS.

In this class, while there has been much done with reference to improvement, there is little or nothing that is radically new. All the well known forms of cutters have admirers among inventors, who seek by one way and another to better them in different respects. There has been scarcely a cutter patented, however, in which the improvement is limited to a single feature. Those familiar with cutters understand that there are two objective points in these machines, the feeding and the cutting mechanism. With reference to the first, the aim seems to be to get a sure and variable feed; that is, a system of devices which will present the fodder with certainty and by which the length of the cut may be varied. This is generally accomplished by a pair of rollers, between which the straw passes, and to which motion is communicated from the cutting parts by cog-wheels and pawl or other suitable gearing, already exhibited in a hundred different shapes, and apparently susceptible of infinite variation. With reference to the cutting mechanism, there is nothing to be observed, save that during the past year there has been a decided tendency in favor of hand-lever cutters.

BEE-HIVES.

It will be observed that of the enumerated subjects of invention bee-hives form a considerable class, and there is no invention of more absorbing interest than these same little rectangular edifices. Here the inventor no longer has to deal with the sluggish earth and the dull clod, but with an organic structure and instinct which for ages has been a fruitful subject of instruction, amusement, and profit. The apiarian inventor of to-day, shunning the brutal practices of suffocation and starvation which in past ages so foully disgraced bee-keepers, looks to the health of the stock and the sanitary condition of its domicile with the tender interest of a kind physician.

Seemingly effective safeguards against that inveterate enemy, the moth, have been provided. Of these the illuminated chamber is, perhaps, the most practical and efficient. It consists of a chamber situated beneath the hive and provided with floors of a transparent substance, which admits the light and thereby allures the miller to deposit her eggs in a place where they can be readily detected and removed.

In frames for the comb many improvements have been made, but of these there is but one which merits particular mention by reason of a distinctive individuality. The movable comb frame still stands pre-eminent. In past years there have been patented of movable frames

some which lift bodily out of the chamber, some which turn on hinges or pivots like a door, others which slide vertically in grooves like window-sash, or in horizontal planes like bureau-drawers.

The particular improvement referred to has movable frames arranged on horizontal pivots, whereby the frames may be moved through vertical planes without disturbing the comb. Two sets of frames are provided for the hive, one in the main chamber and the other in the surplus-honey apartment. The former are pivoted at the outside lower corner and the latter at the outside upper corner, so that each may be gently swung outside of the hive, when the comb may be readily removed and the frames then replaced in the hive. While many patents have been granted for devices designed to equalize the temperature of the hive and to promote ventilation, but little is observable that is really distinct from the inventions of previous years. The system of double walls with dead air spaces between them finds many admirers, while nearly all unite in the use of perforated slides and adjustable buttons for the admission of air.

Of late years considerable attention has been paid by inventors to the selection of material for the hive. At one time straw was about the only recognized element, but this by degrees gave way to wood. Inventors did not rest here, however, for we have patented hives composed of corn-cobs, of glass, of iron, of earthenware, of plaster, of paper, and of carpet. The last two are rather irregular structures, that of paper being composed of a number of layers molded or shaped and colored to resemble a hornet's nest. The entrance for the bees is at the bottom of the structure, and the top is provided with a slotted honey-board, upon which surplus-boxes may be placed and covered with a suitable cap. This hive was patented in 1869. The carpet hive was patented in 1868, and is composed of a skeleton frame or trellis, from which the textile covering is to be removed during warm weather, thus exposing the busy artisan fully to view. As the weather grows cold the carpet is to be thrown over the trellis and the hive permitted to remain on the stand. Bee keepers should satisfy themselves on two points in connection with this hive, that the bees will work in the open air and that the carpet covering will be a sufficient protection against the cold and the ravages of mice. Neither the super nor nadir system of hiving seems to meet with patronage, while some attention is paid to what may be considered a modification of the collateral system. There is not, as far as we know, a single instance during the past two years where an inventor has brought forward a hive intended to prevent swarming by simply enlarging laterally the size of the hive, and thus giving more room to the stock; but several patents have been granted on "dividing-hives," *i. e.*, hives which may be separated into halves, to each of which a new empty section similar in structure is added, whereby two stocks are produced from one, and swarming, it is claimed, prevented.

FARM GATES AND FENCES.

In the improvement of farm gates and fences there is no sensible diminution of interest and but little that is decidedly different from the efforts of previous years. The most of the patents granted are for portable rail-and-panel fences, on which the patents may already be counted by hundreds; few wire fences and fewer hedge fences are noticed, while brick, mold, and sod fences have each only a single patent during the past two years.

There has been a goodly number of gates intended for farm use patented during the year. It is difficult to decide which of the many styles

of gates already patented meets with the most favor. Swing gates, sliding gates, tilting gates, drop gates, folding gates, and slide-and-swing gates have each their party of improvers. Numerically, however, the "slide-and-swing" gate stands at the head of the list. This gate, the first patent on which was granted in 1862, is composed of a panel of horizontal rails with two end battens; between any two of the rails is placed a roller journaled into a swinging frame composed of two vertical posts united together at the top and bottom and pivoted on hinges like a swinging gate. The panel slides back on the roller until the center of equilibrium is reached, when it is swung around by means of the pivoted frame out of the way of passing vehicles. This gate, by reason of its simple structure, the ease with which it may be manipulated, and the fact that it is not liable to sagging like a swing gate, commends itself to such extent that the improvements having reference to it are more numerous than on any other description of gate. The improvements are generally on the swinging frame, although some have reference to latching devices.

CHURNS.

The ardor of inventors of churns continues unabated, and there is no decrease in the number of patents issued on these devices. There are now in the Patent Office, at a moderate computation, models of at least a thousand churns, a large majority of which have been patented. Every imaginable variety is represented—the plain dash churn, the rotary barrel or Dutch churn, the churn with revolving beaters either horizontal or vertical, and the atmospheric churn. Most of the patents are for improvements on the styles of churn enumerated. Some deal with the shape of the vessel, many with the actuating gearing, and a large number with the configuration and arrangement of the dashers and beaters. Occasionally we find a rocking-chair and a churn combined, so as to utilize the former, applied for the quieting of the baby, to the further purpose of churning the butter; and clock-work gearing, to be wound up and continue going till the butter comes, is not unfrequent.

The most notable departure from the established theory in reference to the construction of churns, viz., that they should be so made as to obtain the greatest attrition possible of the cream or milk, is seen in a churn entered during the year, in which the inventors dispense with attrition altogether and rely upon "force and filtration." To this end they take a vessel of any suitable shape, provided with a bottom of any material which will admit of the passage through it of the aqueous portion of the milk, but which will not allow the buttery part to pass through. Upon this bottom they pour the milk and then apply a dasher or cushion fitting tightly into the vessel like the piston of a force pump, which, upon being pressed hard down upon the milk, expels the aqueous portion through the filtering bottom, the butter remaining. The whole operation, if it can be performed at all, may be done as well in a minute as in an hour.

MILK COOLERS.

There has not been much done with reference to other dairy implements except milk coolers, in which an interesting movement is noticeable. The necessity of an apparatus by which milk may be cooled rapidly without being suddenly chilled has attracted considerable attention, and during the past year there have been several inventions providing means for the following established theory in regard to milk coolers,

viz: Such a construction as will admit of a channel of milk being conducted in a direction opposite to that of a current of cold water, the milk being separated from the water by a thin metal partition only. The coolers patented are somewhat complicated in structure, hence we abstain from a specific description of any particular one, and give a brief statement of a structure which, although simple, embodies the principle contained in the others. To construct this cooler it is only necessary to take two shallow vessels of the shape and nearly the proportionate depth of ordinary bread pans, which should be laid one upon the other and firmly soldered together. Now make an opening at the right-hand end of the upper vessel, into which introduce a water supply-pipe and an exit passage for the water at the other end. Provide the lower vessel with a milk supply-pipe and an exit duct in the same manner, but arrange this milk supply-pipe at the end opposite to that on which the water supply-pipe is placed. In operating this it will be seen that the milk will enter at the end opposite to that at which the water enters; so that that portion of the water which comes in closest relation to the warmest milk, or that just poured into the vessel, has already traversed the entire length of the vessel and just above the current of milk flowing in an opposite direction, by which its coldness has been sensibly moderated. Thus the coldest water, or that just entering the vessel, is applied to cooling the coolest milk, or that just leaving the vessel; and the warmest water to the freshest milk, or that just poured into the vessel, and thus all danger of chilling is avoided, and the cooling is accomplished rapidly and certainly. This valuable principle has been embodied in several patents of the past year, although not strictly novel in them, being embraced in a patent granted in 1866.

While a specific reference has not been made in this examination of the agricultural patents to every individual class enumerated in the foregoing list, attention has been bestowed on the most important.

PROGRESS OF THE BEET SUGAR MANUFACTURE IN EUROPE.

The growth of beet roots for the manufacture of sugar and spirit forms the most important agricultural industry of France, Belgium, and Germany, and constitutes a great source of national wealth. A journal specially devoted to the sugar interest in France (*Journal des Fabricants de Sucre*) has been supported for the last ten years, and Stammer's Year Book of Sugar Manufacture does a like office for the Germanic people. According to late returns there are now in France 470 beet-root sugar factories; in Belgium 116; in Prussia 255. In the Zollverein there are annually worked up for sugar 2,500,000 tons of beets. Outside of these two first-named countries there are large quantities of sugar made in Austria, Russia, Hungary, Spain, and other parts of Europe.

The cultivation of the sugar beet is extending in England. Hitherto in Great Britain no attempt has been made to obtain sugar from this root, lest it should interfere with the colonial sugar trade; but it is now believed that the plant may be advantageously grown for the production of alcohol by distillation. Robert Campbell, late member of Parliament, owner of Buscat Park, in Berkshire, has established the stills and other apparatus on a farm of over 3,000 acres, and has committed the management of the works to Savalle, Sons & Co., of Paris, who some time since set up similar works in Austria.

A very valuable report on the chemistry of the sugar beet has been made by Professor Voelcker, of Cirencester College, England, printed in the Journal of the Royal Agricultural Society of England, vol. 5, p. 349, 1869. The experiments of the professor were confined to the white Silesian beet, which, though not yielding so large a percentage of sugar as the French or Belgian and the Quedlinburg, is more extensively grown in France and Germany than any other variety, as being of a more vigorous growth, and yielding a greater weight of roots, and a larger amount of sugar per acre.

Professor Voelcker's experiments have been of the greatest value to Great Britain, since they have served to completely remove the idea that its climate is not adapted to the growth of the most approved variety of beet; an idea supported by the failure in the early attempts to raise beets and to make sugar at Chelsea, Wandsworth, Minely, Belfast, and other places. Voelcker's comparison by chemical analysis of the sugar beet grown in England, Belgium, and France, shows that the British climate is well fitted for the growth of this root, and Mr. Duncan's practical results at the sugar factory at Lavenham, in Suffolk, have set the question finally at rest. In the second season the factory was supplied with 4,000 to 5,000 tons of beets, which it disposed of at the rate of fifty to sixty tons per day. Hitherto at Lavenham he has stopped short of the production of the actual sugar in a crystallized state. As the refiner reduces the imported sugar to a fluid state by the addition of water, Mr. Duncan, having purified the juice of the roots, and evaporated from it sufficient water to reduce it to syrup, transports it to his refinery in London, where he operates upon 500 tons of colonial and continental sugar per week. This system differs from the continental plan. Most of the sugar there passes through the hands of the refiners, but is always run down to form a dry, amorphous mass, which must be again dissolved before being refined. Mr. Duncan saves the expense of the evaporation of the syrup to dryness, and has no residuum. It is doubtful whether this will be the ultimate condition of manufacture, since the process of Rousseau appears to be a more advantageous form in which to carry the sugar, as regards its safety from alteration as well as the facility of transport.

There has been much doubt as to the suitability of the climate of England to beet cultivation. It is not so much heat as a dry and unclouded sky which is needed during the autumnal months, and which makes the sugar in the beet. It is also of great consequence whether the end of April and the month of May are wet or dry. Voelcker, speaking of England, states that the more rain that falls on the land during the first two months of the growth of the beet, the better the crop is likely to turn out if a dry autumn follows.

In England a light, very porous, and naturally poor soil is not suitable for the beet, and will not produce the crop economically. Such land needs previous manuring and a liberal supply of superphosphate at the time of sowing. The best soil is a good, well worked, deeply cultivated, and thoroughly drained clay loam. An excess of lime in land is not required. Many clay lands contain sufficient manures. The beet should not be grown in newly manured soils, as saline matters prevent the crystallization of sugar; but on very poor land, farm manures or four hundred weight of guano, as recommended by Voelcker, should be applied. He also recommends guano, bone dust, and superphosphate with sulphate of potash; but cautions against the use of ammoniacal salts as increasing the tops and diminishing the percentage of sugar;

against chloride of sodium, for the latter cause, and against nitrate of soda as delaying the ripening.

In France the following is a common rotation: Beet root, wheat, clover, wheat, oats, beet root; or beet root, wheat, oats, clover, beet root. Many farmers have one-third of their land in beet root, some one-fourth, and the larger portion one-half or more in roots, of which the beet is chief. The average crop of the beet is eighteen tons per acre, with land that will produce thirty-one bushels of wheat. Guano is rarely used on beet ground. On the continent of Europe the beet is looked upon as a fallow crop, and it is considered good farming to let it both precede and follow a corn crop, a common practice in many parts of Russia and Germany. In England it is found to follow spring wheat well and not to follow clover or grasses.

To the growth and extension of sugar beet cultivation the north of France owes most of its present riches. The labor bestowed on the soil to prepare it for culture of the beet insures, subsequently, immense wheat harvests; the area of fallow land is greatly reduced; double the number of cattle is supported, while the cost of support is diminished by means of the use of the pulp as food.

M. De Tocqueville, at a meeting of the Agricultural Society of Compiègne, France, stated that the extent of beet sugar cultivation in the department de l'Oise, is more than 11,000 hectares, or one-twelfth of the whole area of France. The transportation of the beet injures the country roads, necessitating constant and expensive repairs. To avoid this annoyance in this department the work of rasping and pressing is now done on the farm in some cases, and the juice is conveyed through pipes often five, ten, and even twenty kilometers, to the sugar factory. The pulp is thus left on the farm, and there is an economy of time, labor, and transport, and freedom from toll to support the wear of the roads. This improvement has been carried out at the manufactory of Vauciennes near Crépy.

In the Journal de l'Agriculture, Paris, edited by M. J. A. Barral, the results of experiments upon the growth of the sugar beet by mineral salts at the farm of the school of Grignon, made by M. Bertrand, are recorded. The mineral salts were chiefly the Stassfurth potash salt, which was used at the rate of one ton per hectare. M. Bernard concluded from his experiments that salts of potash employed alone produce no useful effects on the beet root. A mixture of the potash salt, sal ammoniac, and phospho guano slightly increased the harvest, but not sufficiently to warrant the outlay. Similar experiments made in 1867 show that potash is not a manure for the beet root.

The action of salt as a manure for beet roots has long been acknowledged. The beet is found growing naturally on the sea shore in an atmosphere impregnated with sea salt. Four hundred and fifty to six hundred pounds of salt per acre, mixed with farm manure, purin, or guano, produced, almost instantaneously, a development of vegetation in the beet; but, while these roots are excellent as food for cattle, they are wholly unfit for the extraction of sugar. In manure for the sugar beet there should not exist any common salt, since the salt unites with the sugar forming a double salt, difficult to crystallize, and still more difficult to separate the sugar, entailing great loss in manufacture. The fixed alkaline salts, soda, and potash, are generally objected to for similar reasons, and not only are ammoniacal manures detrimental to the industrial value of the sugar beet, but it appears from some experiments of M. Ad. Renard,* that there is what he calls a migration of nitrogen

* Moniteur Scientifique, July, 1869.

during sugar making in the sap. The nitrogen exists in the plant under two conditions, as in protein matters and in ammonia salts. During the manufacture a portion of the nitrogen is eliminated by the different processes adopted; the lime added for defecation precipitates a considerable quantity in an insoluble form, while another portion is separated as ammonia by the reaction of the alkaline earth upon the fixed nitrogenized matters. MM. Leplay and Cuisinier had previously shown that ammonia escaped into the atmosphere, and Renard's experiments were directed to ascertain the actual amount of ammonia thus liberated, and whether it would be advantageous to collect and preserve it. He found that one liter of juice gave 0.539 gram of nitrogen, corresponding to 0.653 gram of ammonia or 2.193 grams of sulphate of ammonia. From this it would appear that a manufacturer working 20,000,000 kilograms of beets yearly would separate 4.386 kilograms of sulphate of ammonia.

Notwithstanding this objection to the use of ammonia salts in manures for the beet, it is remarkable that Silesian beets grown in England, (Barking Creek,) raised entirely on sewage, and which were subsequently examined by Professor Voelcker, proved the highest in sugar of all the specimens analyzed by him, yielding 13.19 per cent. of sugar, while the albuminous compounds present were in unusually small proportion.

It is by no means settled in France what soil produces beets with most sugar. Leplay states that calcareous soils are most favorable; Marchand believes quite the reverse, that the sugar bears no relation to the carbonate of lime present in a soil; but that it does bear a very manifest relation to the amount of alumina present, and this he thinks is because the clay contains an evident amount of potassa, sometimes up to four-hundredths of its weight, and that this alkali is necessary for its growth, and is always found in the ash of the root, and therefore that the richness in sugar is finally dependent on the available potash of the soil.

The question as to the advantage of removing the leaves from the growing beet with the idea of augmenting the sugar in the root, has been definitely settled by experiment carried out in Germany in 1864 and 1865. In 1864, equal areas of land of similar quality were planted in roots with the following results:

	Pounds.
Beets deprived of leaf three times	13,725
Beets deprived of leaf twice	14,600
Beets with leaf	16,957

A similar experiment in 1865, by different observers, yielded:

	Leaves, pounds.	Roots, pounds.
Beets with leaf	15,292	52,502
Beets deprived of leaf once	21,016	47,410
Beets deprived of leaf twice	26,532	42,716

Subsequent experiments have led many German observers to conclude that there is a loss of thirty to fifty per cent. of sugar by taking off the leaves.

Beets require a fertile soil, abundant labor, and frequent weeding—conditions which are compensated by the advantage of clean land, the destruction of useless weeds, and the raising from the lower beds of the soil mineral food which may subsequently be laid on the surface, and furnish a large and nutritive crop, support a plentiful stock yard, supply an abundant manure heap, and better prepare the ground for wheat than any other crop in the rotation. The most favorable period for sowing seed is between April 24 and May 10, in the district in the latitude of Paris; experience having shown that the saccharine riches of the beet diminish very perceptibly when sowing is delayed beyond the latter date. The fol-

owing table, given by M. Eugene Marchand, in his memoir on the agriculture of the district of Caux, department of the Lower Seine, France, published in the proceedings of the Imperial and Central Society of Agriculture for 1869, shows the influence of the date of sowing the seed upon the total production and saccharine riches of the crop:

Locality.	Date of sowing.	Produce per hectare in kilograms.	Per centage of sugar in the roots.	Sugar per hectare in kilograms
Fecamp	April 24	41, 060	8. 36	3, 508
	May 1	39, 900	8. 20	3, 272
	May 8	37, 660	7. 56	2, 847
	May 15	30, 370	6. 54	1, 986
	May 22	27, 335	6. 07	1, 659
	May 29	22, 140	5. 72	1, 266
	June 5	20, 950	5. 37	1, 125
St. Leonard	May 10	65, 380	11. 68	7, 636
	May 18	58, 690	9. 93	5, 828
	April 30	60, 100	11. 86	7, 128
	May 12	42, 500	11. 13	4, 733
Fecamp, St. Leonard	May 28	29, 350	10. 52	3, 098
	June 7	21, 750	9. 50	2, 066
	June 16	20, 340	8. 68	1, 765
	May 5	39, 100	13. 48	5, 271
	May 12	35, 535	13. 55	4, 815
Aberville	May 19	29, 150	11. 60	3, 381
	May 26	23, 690	9. 57	2, 267
	June 2	20, 750	9. 54	1, 980

The following conclusions drawn from the foregoing by M. Marchand appear to be justified:

1. The weight of product is in proportion to the early sowing of seed.
2. The proportion of sugar increases with the age of the root.

Leplay, in his researches on the sugar beet, had previously shown that the leaves of the beet acquire their greatest development about the 15th of August, and that accumulation of sugar in the roots takes place only when the leaves have obtained their maximum development. This is in accordance with the supposed function of leaves, the assimilation of carbon and the formation of carbohydrates, to which is to be added the tendency of the species not to accumulate in its tissues any extensive deposits of starchy or saccharine principles. As the development of leaf depends upon solar heat, the amount of heat received by the soil or plant during its growth, becomes the measure of the amount of sugar produced within the beet root during that period.

The following figures also from the memoir of Marchand, show these facts:*

Date of sowing.	Total degrees of heat from date of sowing up to—		Relative percentage of heat absorbed.		Weight of crop in kilogs.	Sugar in 100 parts of root.	Sugar in 100 parts of root, heat being supposed to be the cause of production.	
	Aug. 15.	Nov. 1.	Aug. 15.	Nov. 1.			Aug. 15.	Nov. 1.
	°	°	°	°				
April 24	1, 501	2, 464	100. 00	100. 00	41, 960	8. 36	8. 36	8. 36
May 1	1, 452	2, 415	96. 76	98. 01	39, 900	8. 20	8. 09	8. 19
May 8	1, 378	2, 341	91. 81	95. 00	37, 660	7. 56	7. 68	7. 94
May 15	1, 287	2, 250	85. 75	91. 31	30, 370	6. 54	7. 17	7. 63
May 22	1, 196	2, 160	79. 73	87. 64	27, 335	6. 07	6. 67	7. 33
May 29	1, 108	2, 071	73. 85	84. 06	22, 140	5. 72	6. 17	7. 03
June 5	1, 014	1, 978	67. 60	80. 26	20, 950	5. 37	5. 65	6. 71

*In this paper both the metrical and the English system of weights and measures have been mentioned. The following standards will connect them: An *are* is equal to 119.6 square yards, and a *hectare* is 100 ares, or 2.47 English acres. A kilogram equals 2.2 pounds avoirdupois; a hectoliter is equal to 22 gallons, or 2.75 bushels.

This table shows conclusively that, with the lateness of the sowing, the amount of solar heat is decreased, and that the return in sugar and in general weight of crop is diminished in a corresponding ratio; the level of the scale of degrees of heat during the period of growth keeps even with the yield of sugar, the percentage relation being shown in the last two columns, and as the influence of solar heat in producing sugar is exerted upon the leaves of the plant, it proves the influence of the latter upon sugar growth, and hence the impropriety of the practice of stripping off the leaves from the plant at any period of its active growth, especially during September and October.

By the table it will be seen that 1,501 degrees of heat were exerted upon the roots pulled on the 15th of August, and 2,464 degrees upon those allowed to grow to the 1st of November; that is, the latter received fifty per cent. more of solar heat than the former, and yet the increase of sugar does not appear to be more than one-fifth to one-eighth of the total amount. An average of four-fifths of the sugar was produced by the 15th of August, and one-fifth more was added by the next three months' growth. This result is similar to the result obtained in the experiments made in the laboratory of this Department during the summer of 1866 and detailed in the report for the year 1867, in proving that the increase of sugar, during the later months of the beet growth, is so very slight that, practically, nothing is gained by allowing the roots to remain in the soil, when by their removal the land might be prepared for another crop. The report alluded to* shows that the sugar figure increases with the rain-fall very remarkably, so that solar heat alone should not be looked upon as the sole determining agent or cause of the sugar ratio, but that moisture or rain-fall should also be considered. It is interesting to observe the similarity in the sugar value of the roots in the later weeks of growth, whether the roots be grown in France or in the United States.

At the general meeting in 1869 of the French Society for the Encouraging of National Industry, M. Heuze read a report on the system of agricultural distilleries, as developed by M. Champonnois, and applied on a great number of farms in France, and in other countries of Europe.

This special industry, the manufacture of alcohol from beet root, had its origin fifteen years since, when the successive failures of the vintage harvests greatly increased the price of alcohol, which had been hitherto manufactured from grapes, first, in the regions of the south and southwest of France, by the distillation of poor and spoiled wines; and, then in the region of the northeast, by the distillation from the Jerusalem artichoke, or the potato.

In the department of the north spirit was distilled from grain, or from molasses; this was pursued with such energy that, in a few years, not only was the deficit of production made up, but a surplus of alcohol was produced, so that the price of alcohol, which in 1864 reached 205 francs the hectoliter, fell in a short time to 50 francs, what it had been in 1858. This produced a crisis in the north, resulting in bankruptcy to many who had established large distilleries. It did not, however, crush out the farm distilleries, which withstood the shock, and gradually augmented in number, so that, in place of two hundred distilleries existing in 1858, the period of the crisis, the number is not less now than five hundred, spread over sixty departments, and the alcoholic production of which is not less than 300,000 hectoliters per year, equal to one-fourth of the total consumption, in France, of alcohol and brandy.

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* Agricultural Report 1867, page 40.

The system of agricultural distilleries of Champonnois consists, first, in extracting from the beet all the sugar it contains for conversion into alcohol; second, leaving in the residuum all the alimentary principles which the root contains; in other words, in separating the beet root into two products, one, commercial and exportable—alcohol; the other, pulp, or nutritious matter, preserved on the farm, and convertible into meat, milk, and manure. This division of products necessitated a different apparatus from the one previously in use, which left three products, alcohol, pulp, and liquor, a liquid which contained all the albuminous and alimentary principles, which was allowed to waste in pits, trenches, and water-courses, and which, by fermentation, became detrimental to public health.

The radical idea involved in the system of Champonnois consists in substituting this waste vinous liquid for water, in displacing or removing the saccharine juice of the beet; thus leaving deposited in the pulp all the alimentary principles with which the vinous liquid was charged, so as to restore the whole constitution of the beet, minus the sugar.

To carry out this original idea, it was necessary that it should be accomplished by the resources at command on the farm; the machinery must be simple and cheap, and easily manageable by the ordinary laborers of the country. The whole apparatus had to be remodelled. In lieu of the primitive root-slicer, of disc-shape, Champonnois adapted a centrifugal root-cutter, by which a perfectly uniform division of the root was obtained, with an economy of power. The distilling apparatus, hitherto made of copper, very expensive, and not capable of meeting the new demand, and which produced a poor wine, very turbid, slightly acid, and corroding the copper utensils, was replaced by column stills of cast-iron, of a more moderate price, and with the portions for exhausting much more effective and safer in the process. These were coated, to prevent corrosion or oxidation, with varnish applied hot; and where the wine was likely to come in contact with the metal, a fixed salt was applied. By thus successively modifying or replacing the old pieces by others better adapted to the purpose, this new industry of distilling beet root was created. To ascertain the real value of these improvements, the syndical chamber of farmer distillers entered upon an inquiry, which included the results obtained on five hundred farms provided with the distilling apparatus of Champonnois. This inquiry has shown that, beet root culture, before the distillation of the root, covered 1,947 hectares, while now it occupies 21,405 hectares; that the wheat crop which then extended over 21,906 hectares, now covers 27.570 hectares; that in these five hundred farms the mean product of corn was 19 hectoliters, 52 liters per hectare, while now it is 27 hectoliters, 75 liters per hectare; that these farms, before the introduction of the distillery, supported annually an average of 26,386 head of cattle, and fattened 6,955 head, while now they are capable of supporting 51,449 head, and fattening 46,656 head; lastly, that these farms, without the Champonnois system of distilling, employed in winter 4,767 workmen, in summer 9,851; while at present they employ in winter 14,718 men, and in summer 25,755.

These data show that this system of farm distillation is a powerful help to the agriculture of the north of France, enabling it to arrive at a cheap production of the cereals and of live stock; in fact, since the establishment of these distilleries, the surface cultivated in beet has increased 19.458 hectares, 5,764 hectares of which, subsequently under wheat, has annually increased the alimentary resources by 251,600 hectoliters of wheat, having a total value of 5,032,000 francs.

The 21,000 hectares, under beet, giving an average of 35,000 kilograms (or 35 tons) per hectare, produce every year 735,000 tons of roots, which, yielding seventy per cent. of pulp, give 514,500 tons of pulp, having, at ten francs a ton, a total value of 5,145,000 francs; and by the aid of this enormous quantity of pulp there have been fattened or supported, yearly, 65,700 head of horned cattle. The animals so treated fifteen years ago on 89,460 hectares, representing the five hundred farms, were only 32,381 head of cattle, or 0.36 head per hectare; to-day there are 98,100 head which represent 1.09 per hectare; these animals produce yearly 411,600 tons of manure, or for every hectare in beet 21,000 kilograms of manure.

The 735,000 tons of beet, at a mean yield of four per cent., have given, annually, 294,000 hectoliters of alcohol, which, at an average of 50 francs per hectoliter of crude alcohol, yields a revenue of 14,700,000 francs, yielding a profit to the state of 20,106,000 francs.

Comfort and occupation are thus carried into the homes of the peasantry, and the tendency of men to rush into cities is checked, by offering to mechanics and artisans occupation in the country, and to farm laborers extended employment from intensive culture.

Of the value of beet-pulp, as an article of nutriment and a fattener of sheep for market, the trials of M. Reisel, a large sheep grower near Paris, are worthy of note, and prove that beets, in any form, whether raw, cooked, or in pulp, suffice to keep animals in a state ready at any time to be brought to the slaughter-house. His experiment with cows had a similar result; he fed seven animals daily with one hundred and six pounds of beet-pulp, from a Champonnois distillery, and, in addition, during the last few days, a mixture of bruised barley and oats, or oats alone.

The first three cows received daily six pounds eight ounces of grain, and the last four only four pounds and four ounces; they were fed from five to six months, and yielded a large profit when sold, considering the value of the pulp and grain.

As this great source of national wealth and comfort is justly ascribed to the effects of Champonnois, the Imperial and Central Society of Agriculture (France) bestowed on him their gold medal; in 1855 he received from the same society the grand gold medal, and the grand medal of honor at the Universal Exposition; in 1856 a gold medal from the Society for Encouraging National Industry; and in 1858 the cross of the Legion of Honor.

The Society for Encouraging Industry having found in the system of Champonnois the complete realization of their views in the creation of mechanical industry in connection with farm labor, have also decreed to him the grand prize lately founded by the Marquis d'Argenteuil.

Among the many processes and improvements which have been developed of late years for the manufacture, there is none which promises more benefit to the public, and especially to the farm manufacturers of beet sugar, than the new process of M. Emile Rousseau, which has for its basis the formation of sucrate of lime.

Years ago Peligot and Pelouze had shown that cane sugar or beet sugar, when it entered into combination with lime, was not altered in its character, and might be separated again without loss of its primitive qualities; in 1838 Kuhlmann had, in laboratory practice, ascertained the stability of the compound of sugar with lime exceeding that of solutions of free sugar, and proposed to separate, by means of carbonic acid, the lime combined with the sugar in the juice submitted to defecation, so as to avoid the use of animal black. This was only, a suggestion,

however; the realization of the industrial process belongs wholly to E. Rousseau, known previously under the name of *saturation*. This method was originally a species of defecation employing an amount of lime proportional to the foreign matters in the sugar contained in the juice made at a low temperature, and upon the consequent neutralization of the lime by means of carbonic acid. In Rousseau's hands this has been a gradual and growing improvement. In 1861 he proposed to heat the sugar juice in the boiler with a few thousandths of sulphate of lime, so as to reunite all the albuminoid matters coagulated into a compact form. The juice thus cleared was then mixed with hydrated peroxide of iron and agitated at a heat below boiling point, which rendered the coloring matter insoluble; the oxide of iron was then removed by rest and decantation, and the clear liquid concentrated. In 1864 Rousseau proposed to substitute for the oxide of iron *sucrate* of lime, and, by forming a chemical compound of sugar and lime, solid, insoluble in the cold, to preserve in that form, and permanently, the sugar of juices or of sirups of the manufactory, and thus to render easy the production and the transport upon the farm. Lastly, as a consequence of this improvement, he invented a new animal black, the low price of which would prevent any necessity for its recovery, and allow of its being rejected for second use; this would completely obviate the necessity in sugar refineries of reviving the black. An attentive study of the properties of bone black had satisfied M. Rousseau that the decolorizing property of black resided essentially in the nitrogenized matters; in other words, charcoal not azotized will not decolor; he then replaced the animal black, or phosphate of bones, with clay, which he calcined with twenty-five per cent. of horse manure, or even with night soil, and thus obtained an energetic and concentrated animal black.

On the old practice, the sugar juices unfiltered and the colored sirups at 25° are filtered through the bone black repeatedly as many as twenty or twenty-five times, and then calcined to restore the decolorizing property. By the use of this new black the filtrations are reduced one-half, the cost of black is greatly lessened, there are no calcinations, as the residual black, when it has lost its decolorizing property, is sold as manure; this, for manufactories where sometimes from 165 to 420 bushels of black are used daily, becomes a notable economy.

Rousseau's improvement of 1866 is not less marked as at present practiced; it consists of converting the sugar of juices and sirups into sucrate of lime, which possesses the following properties:

Sucrate of lime is solid, like fine sand, more or less colored, according to the purity of the original liquid; it is sometimes pure white, when formed in weak sugar liquors, insoluble in concentrated sugar solutions, and almost insoluble in cold water; it dissolves in hot water and in a solution of sugar which is twice as strong in sugar as the sucrate. Incapable of undergoing fermentation, and consequently free from moulding or undergoing internal changes, and not liable to attacks of parasitic animals on account of its alkalinity, its preservation unaltered is assured for an unlimited period.

This sucrate contains in the moist or fresh state from forty to fifty per cent. of crystallizable sugar, and when dried seventy per cent., so that in a small volume and with an augmentation of weights of between thirty and forty per cent., it concentrates all the saccharine riches of any plant, whether cane, beet, sorghum, or other sugar-producing plant. As a transportable material the sucrate will cost no more than crude sugars, as the difference in weight of the lime is not greater than the weight of the impurities. Distant manufacturers can purchase sucrate

to add to their own production, and the work can be carried on during summer; thus many advantages depend upon the form of the sucrate.

The mode of forming the sucrate (*sucratation*, as it is called in French) is as follows: After the ordinary juice—cane or beet—fresh from the rasp, is defecated with sufficient lime to coagulate albuminous and cheesy principles, the juice is evaporated in a pan to mark from 30° to 32° of the areometer, then left to cool. It is upon this cold juice that sucratation is effected, for as the sucrate of lime dissolves in a hot liquid it is necessary to act upon the juice or sirup at ordinary temperatures. The sucrating vessel is of cast iron, circular, furnished with a lid traversed by an arbor with spokes or pallets, and a hopper worked by rack-work, to allow the lime to fall in proper quantity into the juice while the latter is being agitated with the pallets; this hastens the combination of lime with the sugar; the quicklime has been treated with water beforehand to bring it into the condition of a calcium monohydrate, and reduced to fine powder. By the agitation crystals form and agglutinate with the development of heat, the grains increase in size, become more dense, and by the constant stirring fall to the bottom in masses, and if the agitation be carried on to the completion of the union of lime and sugar the whole liquid becomes a solid mass. One hundred parts of sugar absorbed fourteen parts of lime in laboratory trials and nineteen to twenty parts on a manufacturing scale.

In place of pushing the process to this point, only half of the liquid is sucratated and the product formed is removed from the vessel, placed on a sieve, drained and dried. The other half of the sirup remaining in the vessel is strengthened by new and cold sirup weighing 30° to 32°, and half sucratation again effected as above. This is repeated up to the last batch of the day's work, which is sucratated completely. As this last operation contains all the saline matters of the whole liquids united, it is set aside as impure sugar.

The sucrate thus obtained may be dried still further in the air until it loses twenty-seven to thirty per cent. of its weight, when it will be found to contain in one hundred parts seventy parts of sugar, twenty of lime, and ten of water. Thus dried it has a gray or brown color, like manna to the touch, and when strongly pressed between the fingers falls to powder. Nearly insoluble in cold water it may readily be freed, by washing from the traces of sirup adherent to it, and it is then pure and perfectly white; it may now be boxed and put in bags without fear of undergoing any change.

The apparatus necessary for a manufactory of this kind is independent of the ordinary apparatus required for extracting the juice, as rasps, mill, press, generator, and movable steam power as employed on farms. There is only required, in order to work up nine to fourteen millions pounds of beet-root, two large defecating vessels of sheet iron, two evaporating basins, and sucratating vessel, as described; this apparatus has not cost in France more than 30,000 francs.

By the manufacture of sucrate of lime on the farm, the end hitherto sought in the culture of the beet, it is believed, will be attained. The beet-juice being converted into sucrate in winter, and the sugar stored up in a marketable form to be transported in summer, there is left to the farmer the pulp for fattening his stock without loss of any of the fertilizing elements of which the soil had been robbed, and which can be returned directly to the land.

With four or five thousand tons of beet this manufacture begins to be profitable, and the farm laborer is assured of constant employment through the winter. In a previous part of this article, the value of

the distillation of beet-juice was shown as an addition to farm culture. It is believed that the Rousseau process is even more valuable than the distillation; for it takes two of sugar to make one of alcohol, and the alcohol must be sold at a low figure, and its employment is limited; but the consumption of sugar is unlimited, and the establishment of a sucrating establishment is much less costly than a distillery.

This process of Rousseau promises to produce a revolution in the manufacture of sugar, and well deserves the attention of all farm and merchant manufacturers of sugar, whether from sorghum, beet, or cane. It has been put in actual practice in the West Indies, with success, and the sucrate from that source is now an article in the sugar market at Havre, (France.)

From Hon. C. C. Andrews, minister resident of the United States at Stockholm, we learn that—

Beet-sugar manufacture is in its infancy in Sweden, there being only two factories in that kingdom—one at Stockholm, built in 1869, and one at Landscrona; three additional factories are in course of erection. The machinery has been brought from Prague, the complete outfit for one factory costing $67,000, the capacity of which is from 9,000 to 10,000 tons of beets yearly. The roots are purchased at twenty-six cents per hundred pounds; are not so rich in saccharine juice as those raised in Germany or France; nine per cent. is the average richness of the juice in sugar. One crop of beets is taken off the land every third year, phosphatic manures being the chief amendments. To encourage the cultivation of the beet the manufacturer has, in some instances, contracted with the farmers, guaranteeing a net profit of $10 per acre, with the conditions that the instructions of the manufacturer are to be followed and that he has the liberty to inspect. For a factory of the above capacity 750 acres require to be cultivated. The seed is usually sown in April, and, in order to obtain a good variety, the practice is to cut out a small slice from several beets supposed to be of superior quality. Each piece is then put in a solution of salt in water; those which contain much sugar will sink, and those beets from which they were cut are planted for seed. The roots are fit for lifting at the close of September, and the factory works from then until sprouting commences, about the middle of February. The roots are stored in heaps or long pits, with open passage ways through them to prevent heating, and covered with clay on outside to keep off frost.

The Rousseau process, already described, is adopted in one of the factories.

Through the kindness of Mr. George T. Allen, United States consul at Moscow, Russia, information has been received at the Department of the progress of this industry in that extensive country. Mr. Allen has forwarded a letter from Mr. James, an extensive grower and manufacturer in the government of Voronetz, about 200 miles south of Moscow. Beets are extensively cultivated in the southern and southwestern parts of Russia—in Kiev, Karkob, Pultowa, and Tchernia. The factories are large, and surrounded by large beet farms from 1,000 to 2,000 acres in extent. In the central states the farms do not exceed 500 or 600 acres, but the factories are worked with energy; and although the winters are severe, the crops are abundant, remunerative, and certain; Mr. James stating that, during a period of eighteen years, he only experienced four unfavorable summers. When the northeast wind blows in spring, flies and caterpillars will often destroy a whole crop in a few days. The average yield of beets is from nine to ten tons per acre, the juice yielding seven to eight per cent. of sugar in the middle governments; those grown further south yielding more sugar. Boggy or peaty land is found to be very injurious to the sugar beet by introducing too much saline matter and probably nitrates, the presence of which involves extra expense and trouble to separate the sugar from. New and rich lands should always be cropped two or three years, otherwise the beets become too saline. When well manured with bone-dust or bone ashes the ground is commonly cropped three or four years successively, without

change, and then yields fine crops of wheat, oats, and rye. When the beets are left out in autumn the leaf and small end are cut off in the field, and, as the beet root is driven home, cattle, horses, pigs, and sheep feed on the refuse, which affords two months' fodder. When the juice is pressed from the pulp the latter is stored for winter. Mr. James buys in autumn 150 or 200 bullocks, which are fed through the whole winter on this pulp, with the slight addition of straw and hay; in March they are fat and are sold with good profit, leaving 4,000 to 5,000 tons ot manure. The treacle which is left from the draining of the sugar is sold to distillers.

In the yearly report for 1867 reference was made to the process of Schuzenbach for treating beets to obtain the sugar, the main feature of which consisted in slicing and drying the beets beforehand, which allowed the storage of the beet and its manufacture throughout the winter without any further loss of sugar by fermentation or internal changes within the root produced by frosts or sprouting; this process has not been generally adopted. Since then he has introduced the use of alcohol to remove the sugar from the sliced beets. This improved process can hardly be economically or extensively applied in this country on account of the high price of alcohol. It has not yet been adopted in any large factory in Europe.

The following communication upon the beet and beet sugar in Europe has been furnished to the Department by M. B. Landreth:

BEET SUGAR PRODUCTION IN EUROPE.

SIR: I have the honor to present, in accordance with your request, notes upon the culture of the sugar beet and its manufacture, made during my tour of observation in Europe, to which I have added such other facts, obtained both at home and abroad,. from various sources, as are deemed timely and suggestive in the present state of home progress in an interesting industrial experiment.

The beet is indigenous to Central and Western Europe, being found wild from Northeastern Germany to the coast of Portugal. This root serves three purposes: first, as a table vegetable; second, as an article for stock feeding; and, third, for the manufacture of sugar and alcohol.

It belongs to the botanical division of plants called exogens, or those which grow from the outside and have two cotyledons, or seed leaves. It is also a biennial plant, and, like others of its class, matures its seeds and terminates its existence in two years. Its generic name is *beta*, from *bett*, the Celtic for red. The French called the long red beet *betterave*; and it was afterward called by the English "root of scarcity," probably from the fact that in times of famine those in need ate it, but at other times it was not used for food. Even to the present day this root, so generally used upon the tables of our people, is a stranger to those of our transatlantic cousins, and when used by them is rather for a garnish than as a distinct dish. The foliage, however, of some of the white varieties is in very general use there, the lamina of the leaves being used as spinach or in soups, and the midribs boiled and eaten with melted butter, as we eat asparagus.

There are many varieties in cultivation, the distinctive marks being those of shape, size, and color. The variety most noted for sugar production is the white Silesian. It is of a conical form, with a small crown, and grows almost entirely under the surface, with few lateral or side roots; the skin is thin, the flesh firm and brittle, and the taste sweet.

The ordinary sugar beet, raised for cattle-feeding, is frequently found more erect in habit than the true type, and rises considerably above the surface.

The beet is not an exhaustive crop when grown for sugar, as the saccharine matter is nearly all derived from the air. The ash and the woody fiber, returned to the producer in the form of cake, are used for feeding to cattle or for manure, thus ultimately restoring to the soil the elements of fertility which the beet has extracted. It has been calculated that a ton of beet roots removes from the soil about five pounds of potassa, three pounds of soda, one-half pound of lime, one-half pound of magnesia, two-thirds of a pound of phosphoric acid, two-thirds of a pound of sulphuric acid, five pounds and a quarter of chloride of sodium, half a pound of silica, and one-eighth of a pound of oxide of iron.

Land devoted to this culture is more thoroughly worked and better manured than

when cultivated with any other crop; and, instead of being impoverished, increases yearly in productive qualities. If farmers who grow mangolds and ruta-bagas for stock-feeding knew their own interests, they would cultivate the sugar beet instead of these, as this root contains twice as much saccharine matter, and produces a gross weight nearly as heavy as either. It may be said, however, that as the ruta-baga requires only a few weeks to mature, and yields so large a quantity of succulent food for winter feeding, its culture is likely to increase rather than to diminish, even though it is comparatively devoid of saccharine matter.

CONTINENTAL FACTORIES AND FARMS.

The first permanent factory in Europe was established soon after the beginning of the present century, and to such an extent have these factories multiplied, that the combined sugar production of the continent now equals that of Cuba, the greatest sugar-producing country in the world; and, on account of the political disturbances in that island, and the cost of transportation and other expenses, it is now likely to reach the annual production of a million tons. Then the European manufacture will almost balance the united weights of all the crops of cane-sugar produced in the commercial world.

In countries where sugar is cheap it has become an ordinary article of food. Thus, the quantity annually consumed by each inhabitant of Venezuela is one hundred and ten pounds, while in England it is only forty pounds; in Holland, fifteen pounds; in France, fifteen pounds; in Ireland, four pounds; in Italy, three pounds, and in Russia two pounds only. The annual consumption in Great Britain, in the year 1700, was about 10,000 tons; it is now not less than 600,000 tons. In France it is about 276,000; in Germany, not quite 200,000; in the United States, about 400,000; and in the entire world, about 2,300,000 tons. In Germany the cost of production is about five cents per pound.

In France one farmer, near Calais, has annually five hundred acres in sugar beets, and a factory of his own upon the estate. His land, for this crop, is plowed eighteen inches deep, with plows drawn by sixteen oxen, and his yield of roots averages eighteen tons per acre. He fattens yearly about four hundred oxen on the box system, which is the true one, from the pulp raised and pressed upon the farm.

Another farmer, near Tours, last year had 1,250 acres in sugar beets; the yield being from twelve to fifteen tons per acre. He works his crops into alcohol or sugar, as the respective prices promise the most profit. It is said, in France, that the distillation of alcohol from the beet is as profitable as sugar making; and that a few years ago, when the vine disease cut short the ordinary production of wine, and the price ran up accordingly, many sugar manufacturers turned their attention to the production of alcohol, although there are nearly four hundred beet-root distilleries in permanent operation in the empire. The annual production of beet-root alcohol in France is said to be over 6,000,000 gallons. The alcohol manufactured, however, is not equal to that from the grape. In France, last year, the increase in the area planted with beets was ten per cent., and that without protection against foreign sugar. In that empire, where this industry was instituted as a political and military measure, it has proved to be a great blessing, not only to its own people but also to their neighbors.

As an illustration of its success, and the high estimation in which it is held by reason of its indirect, as well as its direct results, may be quoted the following inscription, which occupied the most prominent place on a triumphal arch erected at an agricultural meeting at Valenciennes:

"*The growth of wheat in this district before the production of beet-root sugar was only* 976,000 *bushels, and the number of oxen* 700. *Since the introduction of the manufacture, the growth of wheat has been* 1,168,000 *bushels, and the number of oxen* 11,500."

In another district, where 8,000 acres of wheat were sown, and where there were 6,995 head of cattle before the introduction of this industry, there are now 18,000 acres of wheat sown, and the number of cattle has increased to 40,656.

It has been observed that those farmers who produce beets and beet sugar are the first men of their respective neighborhoods, an unerring evidence among agriculturists of good tillage, good system, and energy and capital rightly applied.

In Germany and Austria the estates are so large, and the amount of capital in individual hands so great, that the entire process of growing and manufacturing is frequently carried on by the proprietors. One establishment near Halle comprises 10,000 acres within its boundaries, and in this locality are found many of the best managed sugar-beet farms of Europe.

Near Cologne is the farm of the Rhenish Beet-root Sugar Company, a concern owning a farm of 7,200 acres, and drawing immense quantities of roots, in addition to their own produce, from the surrounding country. This enterprising firm has issued printed instructions for the guidance and instruction of the farmers of the neighborhood, which, it may be readily apprehended, has led to excellent practical results. Their average

production is twelve and one-half tons to the acre, for which the company pays about five dollars per ton, returning the pulp to the producers free of charge.

A Belgian farmer and an extensive grower of sugar-beets, having his own factory and distillery, transports his crops to the presses, and the pulp back to the different stables, if to be used as food, or to the fields, if as manure, on iron tramways, of which he has eight miles on the one estate.

In Bavaria strenuous efforts are being made to increase this important branch of agriculture and manufacture, and with this view the roots were carried, and perhaps are yet, on all railroads at a greatly reduced price, and the residuum was returned by the manufacturers to the producers free of charge.

In Austria the production of sugar is rapidly increasing. In 1850 the yield was only 10,000 tons; in 1867 it was 100,000 tons.

CULTURE IN ENGLAND.

The growth of beets for sugar has been several times attempted in Great Britain, and thus far with ill success, on account of the want of a propor appreciation of the various requirements, as climate, soil, mode of culture, and other practical facts without which the theory is of little value.

The first attempt to manufacture beet sugar in England was at Malden, in Essex, about the year 1828. It was soon afterward repeated at Chelmsford, and in 1851 in Ireland, but all efforts failed to permanently establish it. It is now, however, likely to be a very important branch of trade in England, as extensive operations have proved that, from the first planting of the seeds to the refining of the sugar, the entire enterprise can be successfully prosecuted in that climate. The amount of beet sugar imported into England before 1860 was quite small, but since that date the demand has annually increased, until now, from France alone, the yearly importation is 70,000 tons.

The culture of root crops is thoroughly understood in England. According to the agricultural report just published it appears that two million seven hundred thousand acres of land in Great Britain and Ireland were devoted the past year to the growth of turnips, ruta-bagas, mangolds and carrots.

Mr. Duncan, of London, has been the first to make a large personal venture. He has erected works at Lavenham, Suffolk, at a first cost of six thousand pounds sterling. His machinery is of Belgian manufacture, and is of fifty-horse power, and requires the attendance of over one hundred hands, night and day, during the busy season.

The results of last year's trials have proved that the roots can be as successfully grown there as on the continent, and that the manufacturer is certain to realize a handsome profit. Nay more, that the percentage of sugar contained in the beets grown at Barking, and analyzed by Professor Voelcker, of London, is two to three per cent. greater than that in the average continental root, while the average production per acre is also greater. Mr. Duncan's works have a capacity sufficient to use up sixty tons of roots a day, and in a season of one hundred working days would require 6,000 tons, (the product of 300 acres,) which, with the requisite alternating crops, would be the yield from 2,000 acres. For all roots raised outside of the establishment, the price paid is $4 80 per ton.

In England, the seed is sown in April, at the rate of about eight pounds to the acre. It is drilled in rows drawn twenty inches apart, and upon the flat surface, that the roots may be removed as far as possible from the drying and hardening influence of the sun and air. In cases where the "stand" is thin, it is made up by transplanting from better portions of the field, a process which, in Europe, can be successfully practiced, so successfully, that in certain districts of France and Germany the seed is sown in beds of an area of one-tenth of the ground in which they are to be planted, and in May transplanted to the fields, and set fifteen inches apart each way. This, however, will not do under an American sun, or our tariff of wages.

One hundred and eighty to two hundred roots can be grown on a square rod, which at one and one half pounds each gives an average of twenty-two tons per acre. This yield is commonly obtained, and often fifty per cent. more. If the roots were increased to three pounds each, the yield would be forty-four tons. Even this would only be 1,300 bushels to the acre, a quantity often reached in the cultivation of carrots. When, by proper and continued selection, the foliage has been lessened, they can be grown closer together, and as they weigh bulk for bulk more than mangolds, it is not improbable that at some day we may not only hear of but see forty-four tons to the acre. Seventy tons of mangolds have been produced per acre.

The sewage of London is found to be a highly fertilizing agent, not only inducing a luxuriant growth, but also the formation of a large percentage of saccharine matter.

The entire cost of growing, harvesting, and delivering a crop at Mr. Duncan's Lavenham factory, is estimated at not over $58 per acre, which, if the crop is twenty-five tons per acre, will give a profit of $62.

Out of fifty-one specimens analyzed last year by Professor Voelcker, it was found that

the percentage of sugar in the German roots was 9; in the Scotch, 9.73; in the English, 9.61. Specimen roots fertilized with London sewage were found to contain thirteen and a quarter per cent. of sugar. The proportion of sugar obtained differs more or less at all factories, on account of machinery, of soil, of manures, and of climatic influences.

Until recently, the manufacturers were satisfied with four and a half to five per cent. of raw sugar, but well managed establishments now produce twice that amount; while a few others, possessing the latest machinery and the best chemical skill, extract in the form of raw sugar from eighty to ninety per cent. of the entire amount of saccharine matter contained in the roots.

In Germany twelve per cent. of pure white sugar has been made, but it was not a profitable operation pecuniarily, though highly interesting as an experiment.

PERCENTAGES OF SUGAR.

Sugar is present in nearly all vegetable productions; in many it is that alone which gives them value; in others it is present without any commercial value, but an all-important element in the composition of the plant.

The standard sugars of commerce are made either from the cane, the beet, or the maple; but there are many other productions which are charged with saccharine matter in sufficient quantity for profitable extraction. Quite recently, specimens of sugar and sirup made from potatoes have been exhibited, and it is stated that a factory has been established in Brooklyn for their production.

Chemical analyses of the beet have shown that it contains over twenty distinct ingredients; but its general composition may be expressed in one hundred parts as follows:

Water	83.5
Sugar	10.5
Cellulose	.8
Albuminous substances	1.5
Various organic substances and mineral salts	3.7
	100.0

A GERMAN FACTORY.

Some time ago the writer was invited to visit a sugar factory located in the outskirts of one of the large Prussian cities. The site of the establishment was many acres in extent; the buildings, however, cover but a small portion, the remainder being used as a store-ground for the winter and spring supply of roots. The approach to the factory was between long piles of roots far higher than the visitor's head. The roots were all topped and fiberless, those refuse portions being kept by the producers as cattle food and manure.

Wagons were constantly coming in with loads of roots, which were directed to platform scales to be weighed, 160 pounds being deducted from the ton for dirt, and a receipt given for the net weight. The supply from more distant parts was brought by rail, and in the harvesting season the transportation of roots forms with the company an important branch of traffic. The quantity of roots brought in daily, at the time of the visit, which was during the growers' harvest, that lasts from the middle of September to near the end of November, was much greater than could be used, and they were, therefore, "pitted" in the attached grounds, to be taken out as required.

In the first building attention was called to the hoisting machine, which was similar to the endless chain and buckets used in a grain or flouring mill, except that the chain was larger and the buckets were of the capacity of a bushel. The roots were raised to the third story, and then dumped upon fast-moving gratings, and subjected to the cleansing effects of a powerful stream of water. From this they pass to the grinding machines, which reduced them to an uninviting mass of pulp, which in turn was quickly made into pie-forms by boys, who carefully spread it out, an inch or two thick, upon metal trays, covered above and below with press cloths made of hemp and wool. These trays were placed one upon another till stacks were made three feet high, when they were moved under hydraulic presses and forced downward till the trays all touched one another, the juice running out a clear white liquid, but turning red, and even dark brown, when exposed for a short time to the air, as fermentation begins as soon as the juice is brought in contact with it. When the flow of juice from a stack closed, the pressure was removed, and the pulp found to be a thin, dry, and brittle cake; but, as it still contained saccharine matter, it was broken up, mixed with water, and pressed a second time. There are several other processes for extracting the juice, and two of them, the centrifugal and the diffusive, were in use at this factory.

The latter process is fast superseding the others, being not only as thorough in its

operation, but much less costly in machinery and attendance. In this process the saccharine matter is extracted from the beet roots, which are cut into very thin disks or wafers by the action of water which, penetrating the slices, absorbs the sugar and carries it off.

The pulp is used to a great extent as food for cattle, and as manure. It is better suited for feeding sheep and market cattle than for milch cows or horses, as it has a decidedly fattening tendency, and, with cows, is liable to affect the flavor of the butter, as well as reduce the quantity of milk. A ton of pulp from the hydraulic press measures sixty bushels, and consists of the entire flesh of at least eight tons of roots. Its value in Germany is about three-fifths of the factory price for roots. When not pressed very hard and dry, an excellent beer can be made from the cake by treatment similar to that given to grain intended for brewing. When not wanted for immediate use it is kept in deep pits, where, if well secured from the air, it can be preserved in a sweet condition for two, or even three years. A certain amount of decomposition takes place upon the outside, but the crust thus formed the better preserves the interior.

As soon as possible after pressing, the juice is heated to about 160° Fahrenheit, when a small proportion of lime is added, and the temperature increased to the boiling point. The lime unites with the albumen and counteracts the acid, but no sooner is this effect produced than efforts are made to remove it, as well as the other impurities contained in the juice. This is done by filtration through animal charcoal, or by subjecting the juice to the action of carbonic acid, when it is transferred to the evaporator. There are many methods of procedure in the treatment of the juice, and as many champions for their own favorite processes.

The charcoal required for filtration, after being used, is heated, and in that way purified for use again, as nothing is wasted that can be used. The heat required in the various operations is intense, so much so that the employés work in an almost nude condition.

The product of crystallized sugar was from six to eight per cent., a little more than half the proportion of saccharine matter contained in the roots. The sugar produced was all white crystal, the manufacturers not finding it profitable to make colored sugars. The molasses was formerly used for making a coloring matter and as food for swine, but is now found of considerable value in the manufacture of alcohol, of which, when properly treated, it will yield from twenty-five to thirty per cent.

Considerable capital is required in establishing a factory, but this, without practical skill, will not insure success. The possessor of capital, however, can always obtain the services of experts in this as in all other industrial pursuits. We need not, therefore, be deterred from engaging in an effort which promises to add another outlet for American energy and enterprise.

TRIALS MADE IN THE UNITED STATES.

The production of beet sugar in America was attempted about the year 1830, by a company formed at Philadelphia, under the auspices of the late John Vaughn, and James Ronaldson, the well-known type founder, but failed from a want of practical information upon the subject. Indeed, very little was accomplished beyond importing the seed, which was subsequently disposed of for raising stock-food, and is here referred to only as an item in the history of beet sugar operations in the United States to be hereafter written, when the interest has reached such dimensions as to command the attention of the nation. Eight years later, in 1838, a company was formed at Northampton, Massachusetts. They produced something over half a ton of good sugar; but here, it is said, the experiment ended. The cost of raising the roots was estimated at forty-two dollars an acre, the yield averaging thirteen tons to the acre.

The next attempt was made in 1864 by Messrs. Gennert, at Chatsworth, Illinois. They purchased a farm of over two thousand acres, and erected the proper buildings; but, from causes satisfactory to themselves, they subsequently sold out to an association styled the "German Beet Sugar Company." The capacity of the manufactory is estimated to be equal to 50 tons of beets per day. In 1866 they had four hundred acres of land planted, which yielded 4,000 tons of roots at an estimated cost of less than $4 per ton. The percentage of saccharine matter contained in the roots was found to be equal, if not superior, in quantity to that of the European roots. The past year they had a large area of ground sown, but lost nearly all the plants by a terrific rain-storm, just after they had germinated; the company, however, made about six hundred barrels of sugar.

The next establishment of this kind was instituted at Fond du Lac, Wisconsin, about two years ago, by Messrs. Bonesteel and Otto, two Germans, familiar with the cultivation of the root and the mechanical operations of producing sugar as practiced in Europe. They have proved the soil to be well adapted to the growth of roots well charged with saccharine matter. The location is in nearly all respects satisfactory, but a greater amount of sugar might have been made had operations been conducted on a larger scale, the cost of superintendence being nearly as great in a small as in a

large establishment. The capital employed at Fond du Lac is said to be $12,000. This summer (1869) they cultivated one hundred and twenty acres of beets quite successfully, and have been busily engaged in manufacturing them during the autumn and present winter. The capacity of the works, however, is only equal to about 10 tons of roots per day, from which they extract about seven per cent. of sugar.

A Philadelphian has offered to double their capital for next year, but it is doubtful if they will remain at Fond du Lac, as a company in California has sent them exceedingly rich specimens of beet roots, and made tempting offers for the transfer of their energy and skill to the Pacific coast.*

The latest effort has been made by Colonel Patterson, a Philadelphian, upon his extensive estate in New Jersey. He failed to produce a crop, owing to the lateness of the planting, due to delay in procuring machinery; but, from his well-known energy, we may expect good results in future.

If there should be any doubt as to the success of these enterprises, it cannot arise from our inability to raise large crops of roots, or to conduct the complicated operations of pressing and evaporating, but from the excessive cost of labor, as compared with France and Germany. It is likely that the home cost of West Indian sugar will always be much less than that produced elsewhere, but the supply cannot equal the growing demand of the world.

The product of sugar per acre from the cane in the West Indies is nearly twice that from the beet in Europe, the percentage of saccharine matter being as eighteen to ten; but the labor required to raise the cane is much greater than that given to the beet. It might be difficult to state or draw a reliable comparison in other respects between the two crops, but it is probable that each has its peculiar advantages, so that neither will ever supersede the other. Cane cannot be grown far removed from the tropics. Sugar beets may be successfully cultivated on a broad breadth of the earth's surface. As to the comparative composition of cane and beet sugar, they are identical when perfectly pure, and cannot be distinguished one from the other; but when unrefined, they are different both in taste and smell.

A warm climate is not necessary to grow beets, as in those produced in Russia and in Norway and Sweden the percentage of saccharine matter is fully up to the average. It is stated by M. Gasparin, that for beets to arrive at maturity, they must absorb 4,352°, Fahrenheit, of heat. This estimate he arrived at by multiplying the mean temperature of the season of the crop's growth by the number of days. Still, a genial sun is not objectionable, if there is a sufficient accompaniment of moisture from first to last; on the other hand, there may be too much moisture, which impedes the formation of saccharine matter, although the beets are less stringy than when grown during a dry season.

One of the advantages that the cane manufacturer has is, that the *bagasses*, when burned, is sufficient to evaporate almost its own weight of juice, while in Europe a pound of coal has to be purchased to make six pounds of sugar. From the cost of coal, however, the value of the beet residuum should be deducted. There is a wide difference between the cost of production of cane sugar in Cuba and in Louisiana. A prominent Cuban planter, before the war, gave it as his opinion, founded upon personal experience in both Louisiana and Cuba, that three cents per pound in Cuba paid a larger profit than six cents in New Orleans. This difference is principally due to the climate, the canes lasting there for a dozen years, while in Louisiana they have to be renewed three or four times in that period.

SOILS.

The beet requires rich ground, and, like all tap-root plants, delights in a deep, loose soil. That best adapted to it is a light loam, free from hard clay, and if of a slightly calcareous nature so much the better; of course, freedom from stones and other obstacles to culture, though not indispensable, will greatly lessen the cost of tillage.

It is useless to attempt to grow beets upon an uncongenial soil, as, without success in the production of healthy, well-formed, well-constituted roots, all else will necessarily fail. Hence the first thing to be considered is the selection of an eligible situation; and this signifies not only the proper soil, but proximity to a city or town from which laborers can be procured to work the crop and machinery; proximity to a supply of fuel, either coal or wood, and to a railroad, river, or canal, that the cost of transportation may be as light as possible; and, though the last named, not least important, an ample supply of water, if practicable drawn from an elevation to obviate the cost of pumping.

It is not well to plant upon land fertilized only by material put upon it just before planting, but upon such ground as has been enriched by manure left by preceding crops, or applied the autumn before planting. Nothing could be better than an old sod turned down in the fall of the year, early enough to admit of decomposition and

*They subsequently accepted the offer and have gone to California.—[Ed. Rep.

disintegration by the frost. The soil, either naturally or artificially, should contain plant food to a depth of say twenty inches, that the tap-roots may be induced to continue their descent, and not spread out laterally in search of nourishment, as is too often the case.

The study of the action of different fertilizers is very important, as they affect not only the weight of the crop, but also the amount of saccharine matter which it contains. Rich nitrogenous fertilizers, such as barn-yard manure or guano, should not be applied in large quantities directly to the crop, as they do not favor the production of sugar, but induce an unequal growth, and the propagation of grubs which feed upon the roots. Salt should not be employed at all, as it is prejudicial to the production of sugar. Ashes, bone-black, a little nitrate of soda, all phosphatic manures, and lime, are found to act well in England. Different soils, however, require different applications, and it is only by analyses, and by repeated trials in the field, that a definite conclusion can be reached. The manures applied to the crop should be in as fine a state of division as possible, that they may be the more readily dissolved by moisture; for it is only in the form of a solution that the rootlets can profit by it.

A producer of beets in France reports that he has found that various commercial fertilizers give a better return than barn-yard manure applied in the autumn; but by the exclusive and long-continued use of the former the soil would soon become unfertile, and require increased doses to effect results equal to the first. Under such conditions the rotation system must be resorted to, as this alone will afford relief.

SEED.

The seed of the White Silesian sugar beet can be purchased from any reliable seed-merchant at a moderate charge. In Europe there are several sub-varieties of this species, among which the Vilmorin, the Imperial, and the Gerlibogt are the most highly spoken of. The long blood-red table beet contains a greater proportion of sugar than the White Silesian, and is equally easy of cultivation, but not so profitable, as the process of extracting the color and the odor adds considerably to the expense.

There is as great room for improvement in sugar beets as there is in most plants, by carefully selecting, year after year, proper seed roots, thus fixing the best form, color, texture, and weight in proportion to the foliage. The latter should be reduced as much as possible without interfering with the elaboration of the juices and the general health of the plant. In proof of this assumption, witness the wonderful improvement in ruta-bagas and mangolds by careful selection during the last few years. Formerly they were large-topped, rough, many-rooted, woody, unshapely masses of vegetable growth; now they are not only more productive, being larger, but symmetrical, beautifully tinted, fine fleshed, and with tops surprisingly small in proportion to the bulbs.

This matter of selection of sugar beets for seed, we will, however, leave to our European cousins, as our climate is not so well suited as theirs to the raising of the seed of this variety, though it gives us ruta-baga seed superior to any which can be imported. The freshest seed is to be preferred, as plants from old seed sometimes show a disposition to run to seed rather than to roots. When such a tendency exhibits itself the shoots should be cut off as soon as they appear.

PREPARATION OF THE SOIL.

The land selected for the crop, being of suitable composition and texture, should be deeply plowed and harrowed two or three times. As an evidence of the value of deep plowing, it may be stated that in England beet roots have been known to stop drains three feet under the surface. The Germans plow eighteen inches deep for this crop. Indeed, the deeper the soil the better, as every additional inch which the roots strike down enables them to draw nutriment from an additional hundred tons of soil per acre. In a well broken soil the roots will not be inclined to rise above the surface; and here is another advantage, as the saccharine matter is principally produced and stored up in that portion of the bulb which is under the surface. Neither will they fork, if the main root has a clear, unobstructed road before it. This should be wel. looked to, as the rapid increase of roots is more from lengthening than from an increase of diameter. In short, the weight of the crop seems to be more in proportion to the depth of cultivation than to the treatment with manure. It was an axiom of Tull that deep, thorough tillage may almost supersede manure.

In England there is a popular opinion among farmers that their turnips and mangolds are not so apt to grow with forked roots if lime is liberally used as a manure; and perhaps the use of lime in this culture would have the same effect.

After the necessary plowing and harrowing the ground should be furrowed out in furrows at thirty inches apart and eight inches deep, and a dressing of five hundred pounds of superphosphate per acre applied in the furrows. The sub-soil plow, or breaker, should next be run to the beam in these furrows to open a free path for the

tap-roots. After this, split the ridges with the double mold-board plow, covering the manure, and transposing the relative positions of ridge and furrow. These new ridges should next be well backed down with a triangular drag, or harrow reversed, by which a smooth surface is presented for the drill, with which a man, having a boy to pull, will seed three acres a day. The seed should be covered three-fourths of an inch to an inch deep; and, if the requisite conditions of germination are favorable, the plants will appear above the surface in about five or six days. Good crops have been raised, however, which did not show a sprout for nearly two weeks after seeding.

To induce the seed to germinate, it must be subjected in the soil to the action of heat and moisture: of the first, 60° Fahrenheit, or over; and of the second, sufficient to swell the seed without causing decay.

In the latitude of Philadelphia the seed should be sown about the 1st of May—the sooner the better—as the first crop is generally the best, although there may be a greater tendency to run to seed than in later sown crops.

When the young plants are half an inch high they should be side-scraped with the seven-inch hoes previously referred to, and then cross cut with the five-inch hoes into clumps of three or four plants—the clumps six inches apart. These clumps will be reduced to one plant afterward by hand weeding. This will give about thirty-five thousand plants to the acre. The crop should be kept free from weeds, and the soil loose, that air and moisture may freely penetrate to the roots. With thorough cultivation the roots are not so liable to suffer from variations of temperature; hence the growth is more uniform, and as a consequence the roots are less woody and less liable to shoot to seed. During the entire culture great care must be taken not to injure the leaves of the plants, as with impaired lungs a healthy action is impossible. If the cultivation is properly attended to there is no reason why the roots should not average one and a half pound each, which, allowing for blanks, of which there will always be more or less, and for the ravages of grubs and wire-worms, should give twenty tons to the acre. Last year, under extremely unfavorable circumstances—no rain having fallen for nine weeks—the writer raised fourteen tons of roots and three tons of tops of sugar beets to the acre. The average weight of the roots was a fraction less than fifteen ounces, and the largest averaged a length of twelve inches, and the crown was four inches in diameter.

When the roots are fully developed and ripe, which will be about the first of October, (and may be known by the stoppage of circulation,) they should be taken up; as, if they make a second growth under some atmospheric influence, a large portion of the saccharine matter goes to form the leaves. On the other hand, the roots should not be disturbed before maturity, as the formation of saccharine matter is most rapid at that period. The roots can be taken out by passing the subsoil plow under them, which, if it is run deep enough, will escape all but the extreme points, and by the saving in time more than compensate for the loss of product. Great care must be taken in harvesting the roots that they be not bruised, as those thus injured are more apt to decay than otherwise; and those in a decaying condition produce juices which require double filtration. When topping the roots for storing a portion of the crowns should be taken off with the leaves, or the heat and dampness of the pits may cause the embryo leaf buds within them to burst forth, and this would cause the loss of a portion of the sugar. These crowns are valuable as stock food.

If the roots are to be kept for any length of time they should be buried in trenches about two feet deep and two feet wide. The trenches should be divided, by earth partitions, into sections of about twenty feet, so that the principles of decay which may exist in one locality may not be communicated to the whole.

The roots should be filled in up to the surface and covered with a conical bank of earth two feet high, that the air may be entirely excluded. The sooner roots intended for "pitting" are buried after pulling the better, as the atmosphere will impair their value. The European growers have a proverb, "Out of the earth into the earth."

AMERICAN DAIRYING.

CHEESE MANUFACTURE.

The American cheese factory system, which originated in 1851, had but a slow growth until the year 1860, when only about a score of factories were in existence, since which time its progress has been almost without parallel in our industrial history. The addition which it has made to the national wealth is indicated by the fact that the annual

production of cheese in the United States has been increased from 103,663,927 pounds in 1860, (a somewhat smaller product than that of 1850,) to about 240,000,000 pounds in 1869; while the exports have increased from 15,515,799 pounds for the year ending June 30, 1860, to 51,097,203 pounds for the year ending June 30, 1868.

So great an impetus was given to the manufacture in the season of 1867, that shrewd business men felt lively apprehensions of glutted markets and a revulsion in the trade. Their warnings had a beneficial effect in restraining a too hasty rush into this comparatively new field of enterprise, but their apprehensions of disaster were not realized. American cheese has met with an increasing demand in England—the market which absorbs nearly nine-tenths of our exports of this commodity—and all past experience justifies the opinion that a good article of American production will continue to find ready sale at fair prices. Our factory system is securing that uniformity in make so advantageous to the purposes of trade, and concentrated skill and capital are producing their legitimate effects in a steady improvement in quality. English dealers acknowledge that American cheese is gradually acquiring an ascendency in their own markets, and in view of this state of things English agriculturists are urging more emphatically than ever before the necessity of establishing cheese factories in their dairy regions, and are debating the best course to secure the adoption of the system.

At a recent meeting of the Derbyshire Agricultural Society, England, Mr. Crompton, a prominent member, addressed the society on this subject, which he characterized as of the greatest importance to English agriculturists at the present time. Alluding to the extraordinary progress which has been made in cheese manufacture in the United States within a very short period, he declared that it was a vital necessity to English dairy farmers that they should study the workings of the American system, and utilize the information which might thus be obtained. He pointed out the defects existing in the average of English cheese, and cited the statements of leading dealers in proof of his allegations. For instance: An eminent importer in Liverpool, calling attention to the variation in quality and price of English cheese, said that Cheshire cheese was declining in quality, and that the greater portion of it was of very inferior quality; also that, on going to Cheshire, there would be found a variation of 30*s.* per hundred-weight between the price of middling cheese and that of the very best. Mr. Crompton was of the opinion that as great a variation would be found in Derbyshire cheese. On the contrary, the American cheese received never varied more than 6*s.* per hundred-weight, and two-thirds of it did not vary more than 3*s.* per hundred-weight. A retail dealer in the midland counties, whose annual sales amount to not less than forty tons, stated, by letter, that his sales are equally divided between English and American cheese, adding, "the sale of the latter has very much increased, and if the quality continues to improve as it has done for several years past, the English factor will soon become independent of the English manufacturer, who, unless he improves the quality of his cheese, must give way before the American." The testimony of a large wholesale dealer at Leicester tended in the same direction. As to the improvement in American cheese, this gentleman said that "since the factory system has been introduced into America, more regularity has been attained in the cheese; it has been scientifically made, and out of thousands of cheeses there has been scarcely any variation in color and quality, which can not be said of the products of the best dairies in England."

The preference which American cheese is obtaining among the labor-

ing classes in certain sections of England is strikingly exemplified in the information given by a cheese-seller in the town of Chesterfield, Derbyshire, who states that he sells thirty tons of American cheese to one ton of Derbyshire. This is in a neighborhood where the wages paid to miners and laborers amount to more than £25,000 in a fortnight, the greater part of which is spent in Chesterfield for provisions.

The prosperous condition of the American cheese manufacture is in considerable degree owing to the formation in this country, within the last six years, of the various "Dairymen's Associations," the aim of which has been to thoroughly organize the efforts of this branch of industry. The earliest in date of these associations, and by far the largest and most important, is the American Dairymen's Association, formerly known as the New York State Cheese Manufacturers' Association, which was organized in January, 1864.

The following summary of an address, delivered by I. M. Webb, at the annual session of this Association in January, 1870, contains some instructive particulars respecting the cheese trade with England during the business season, commencing May 1, 1869:

Owing to a reduced available production in the United States, and a diminished production in Great Britain, during the year 1868–'69, the close of that year found market stocks of cheese of all descriptions more completely exhausted than ever before. In consequence, there was a great demand for new cheese, and prices were high. The shipments from the United States in the spring of 1869 were of poor quality, and, though finding ready sales on account of the existing scarcity, did not give satisfaction to dealers. The May manufacture was of excellent quality, and sold at very high rates. The June cheese was hurried to market in an imperfectly cured condition, and, though with this exception, it was of superior quality, and rich in flavor, its failure in solidity, joined with the reaction from former exaggerated prices, brought on a rapid reduction in prices, and shippers suffered a considerable loss. In about two months the low prices touched again created a lively demand in the English market, and though much of the July cheese was imperfectly cured, arrivals were quickly cleared off in time for receipts of August and September cheese, most of which was thoroughly cured and of very satisfactory quality. Sales were ready and prices advanced instead of declining, as in the corresponding period of former years, and rates for really choice cheese were well maintained throughout November and December. Taking the season as a whole, there was shown a decided improvement in average quality, and a larger proportion of really choice cheese than in any former year.

The estimated consumption of American cheese in Great Britain, from May 1, 1869, to January 1, 1870, is 140,000 boxes (or 20 per cent.) more than the consumption for the like period of the year 1868, and 100,000 boxes in excess of that of the corresponding period of 1867. Notwithstanding the increase in American production and in shipments, it appears that the price in New York on the 1st of January, 1870, if reduced to a gold basis, is equal to that at the commencement of 1869, and four cents per pound higher than at the opening of 1868. The high prices at the commencement of 1869 were a consequence of a decreased production for the season in Europe as well as in America. On the contrary, the supply at the opening of 1870 was abundant. While a surplus of the wages of English laborers, resulting from the moderate price of bread during the current season, is stated as one cause of the increased consumption of American cheese in Great Britain, the more effective causes adduced are, the great improvement in its quality, and the judgment shown by

American dairymen in adapting themselves to the conditions of the English market.

The report of the American Dairymen's Association for 1869 enumerates 1,066 cheese and butter factories in the United States, against 803 reported in 1868, and 572 in 1867. To 660 factories are attached 287,318 cows, the number connected with the remaining factories not being reported. These factories are distributed among the several States as follows: New York, 824; Ohio, 85; Illinois, 31; Wisconsin, 31; Vermont, 29; Massachusetts, 19; Michigan, 17; Pennsylvania, 14; Iowa, 6; Kentucky, 5; North Carolina, Maine, Virginia, Tennessee, and Minnesota, each one factory. The increase in the number of factories, as compared with the number reported in 1868, is 263, as follows: New York, 185; Ohio, 13; Illinois, 5; Wisconsin, 23; Vermont, 7; Massachusetts, 4; Michigan, 13; Pennsylvania, 9; Iowa, 3; Maine, 1.

Forty-three factories in New York report averages ranging from 9.14 pounds to 10.11 pounds as the quantity of milk required to make one pound of cured cheese, showing a variation of more than 10½ per cent., attributable in great measure to differences in the skill of the manufacturers. In the same State, in 1868, the averages reported by thirty-eight factories ranged from 9.14 pounds to 10.32 pounds, showing a variation of nearly 13 per cent., and in 1867 the averages reported by twenty-seven factories ranged from 9.33 pounds to 10.50 pounds. The average prices of cheese per 100 pounds, at New York factories in 1869, ranged from $15 to $17 45, against $14 to $16 64 in 1868, and $11 50 to $14 67 in 1867.

While the American dairy-factory system has attained great importance and prosperity through the instrumentality of cheese manufacture, leading dairymen point to the occupation of a wider field and to the attainment of a larger success in the future. As auxiliary to this success they emphatically advise the more general application of the co-operative system to the manufacture of butter, already made in factories to some extent. They show that such an application is entirely practicable, would be highly remunerative, and would be productive of immense advantage to the general community in securing a higher and more uniform quality of that great staple. The argument is a strong one; and the aggregate gain which would result from such an improvement in quality may in some measure be appreciated when it is considered that the value of the annual cheese product of the country, estimated at not less than $36,000,000 for the year 1869, bears but a small ratio to the value of butter annually manufactured, the value of the latter for 1869 being estimated at nearly $210,000,000.

X. A. Willard, well known as a high authority in dairy matters, shows that, at present prices of first qualities of butter and cheese, a stated amount of milk is capable of yielding a much larger profit in the former product than in the latter; and that the extensive application of the factory system to the manufacture of butter will not only give large pecuniary returns to those engaging in the enterprise, but, by opening new fields to competition, will prevent all danger of over-production of cheese, and secure that just balance between different branches of the dairy interest which is essential to their highest prosperity.

In regard to the manufacture of butter and cheese from the same milk, he states that at certain seasons of the year the night's milk may be skimmed, mixed with the full milk of the morning, and manufactured into cheese which will not show any inferiority to that in which all the cream of the milk has been employed, and that repeated experience disproves a hitherto common opinion to the contrary. The philoso-

phy of the case is illustrated by the fact that when the entire cream is used in the cheese it cannot be retained throughout the process of manufacture. Mr. Willard calls attention to the necessity of improvement in curing-rooms for cheese and to the best methods of maintaining them at a low, even temperature during the summer. In regard to the requirements of the home market he observes that there is a want of cheeses of the Stilton shapes, weighing ten to fifteen pounds each, and states that on a visit to the West in the fall of 1869 he found dairymen there manufacturing such cheeses and selling them at 30 cents per pound.

N. W. Woodfin, of North Carolina, reports facts showing the fitness of the Alleghany range in Virginia, North Carolina, Tennessee, &c., for the dairy business; the whole region being of suitable temperature, and well watered, the mountains producing heavy crops of sweet, nutritious pasture grasses. He states that, since the agricultural and geological survey of North Carolina by Professors Emmons and Kerr, there has been manifested a disposition toward a radical change in the agriculture of the western part of the State, some of the citizens now making grass their leading crop. There are three cheese factories in Buncombe County; and notwithstanding many disadvantages they have given satisfactory results. The Elk Mountain Cheese Factory, established in 1868, by a gentleman from Oneida County, New York, is the only one which has yet formally reported to the American Dairymen's Association. This factory is situated on a farm elevated 3,000 to 4,000 feet above tide-water. Its cows give a full yield of excellent milk, and the cheese is of first quality. The dairy season in that locality is eight months in length; the cows require feeding about four months, and shelter during half this period. Mr. Woodfin also reports that in Western North Carolina good farms, suitable for dairy purposes, can be bought for $5 to $15 per acre.

Some interesting particulars concerning movements in prominent cheese and butter districts are contained in the following statements—the first of which exhibits, in tabulated form, the shipments of cheese and butter from Herkimer County, New York, during the years 1864 to 1869:

Years.	Shipments.		Years.	Shipments.		Years.	Shipments.	
	Cheese.	Butter.		Cheese.	Butter.		Cheese.	Butter.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*
1864	16, 767, 999	492, 673	1866	18, 172, 913	232, 961	1868	15, 734, 920	241, 682
1865	16, 808, 352	313, 755	1867	16, 772, 031	204, 385	1869	15, 570, 487	204, 634

The following table exhibits the shipments from St. Albans, Vermont, during the years 1851 to 1868:

Years.	Shipments.		Years.	Shipments.		Years.	Shipments.	
	Cheese.	Butter.		Cheese.	Butter.		Cheese.	Butter.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*
1851	555, 258	1, 192, 968	1857	825, 162	2, 864, 745	1863	921, 842	2, 863, 576
1852	601, 969	1, 149, 235	1858	1, 294, 893	2, 713, 309	1864	923, 210	2, 472, 854
1853	1, 122, 703	1, 939, 354	1859	1, 247, 288	2, 424, 969	1865	1, 174, 261	3, 035, 257
1854	1, 035, 376	1, 712, 404	1860	1, 984, 000	2, 566, 700	1866	882, 495	2, 617, 095
1855	966, 287	1, 715, 127	1861	1, 481, 716	2, 732, 209	1867	925, 357	2, 720, 284
1856	1, 228, 128	2, 393, 668	1862	1, 281, 602	2, 420, 370	1868	948, 276	2, 606, 880

The report of the Ohio Dairymen's Association states that more than four millions of pounds of cheese were shipped from Wellington, Ohio, in 1869.

The dimensions assumed by the dairy interest in parts of the West where the factory system has recently been inaugurated are exemplified in the section around Elgin, Illinois, which has been settled little more than thirty years. In this district, having a diameter of about twenty-five miles, there are 7,000 cows, valued at $350,000. In 1869 the district produced 1,301,056 pounds of factory cheese, and shipped over 1,600,000 gallons of milk, chiefly to Chicago. There was also an estimated production of 200,000 pounds of butter. The amounts of cheese and milk marketed in 1869 show an increase of 50 to 60 per cent. over the quantities marketed in 1868, and 200 to 300 per cent. over those of 1867.

The organization of the Northwestern Dairymen's Association is at present almost entirely confined to the States of Illinois and Wisconsin. The fourth annual report of this association, recently issued, gives evidence that the dairy products of those States are improving in character, and that western cheese and butter will ere long attain a higher standing in the general market than they now hold. The remarks of mem bers at the annual meeting evince a thorough appreciation of the defects which have hitherto attended the manufacture, and of the injurious effect which shipments of inferior products have hitherto had on the reputation, and consequently on the market value, of western cheese and butter, especially the latter. A common interest, therefore, prompts to the diffusion of improved methods of manufacture.

C. H. Wilder, of Evansville, Wisconsin, remarked that, notwithstanding the prosperity of western cheese manufacture, its growth does not keep pace with the consumption, a greater amount of cheese having been imported into the Northwest during 1869 than during any previous year. The increase of product would have been more rapid had not the want of skilled labor deterred the farmers of large sections of the West from engaging in dairy operations. Cheese-making, at the present day, is a science, requiring skill and experience; and to be successful needs the proper co-operation of the milk producer. Even in the older regions of the East dairymen are often careless in selecting stock, and in feeding, milking, and general treatment; and in the West, where dairying is of more recent date, these defects in practice are of still greater magnitude, and the results are visible in diminished quantity and inferior quality of milk.

In illustration of the different results consequent on judicious or injudicious management, a special committee of the association offered the reports of certain dairies exhibiting for the season an average net profit of $80 for each cow, while other dairies report a net profit of only $40 per cow. The committee estimate that the average expense of feed for each animal could not have varied more than ten dollars in the cases named.

The attention of the association was directed to the necessity of the more careful packing of butter, and of adopting a style of cooperage better suited to the preferences of the eastern market; to the advantage of a studious cultivation of the better qualities of grasses; to the very common neglect to provide pure drinking water for cows, and the consequent injury to the quality of milk, enhancing liability to fermentation; to the common but reprehensible method of cooling milk for the factory by adding to it a small portion of ice, thereby damaging the flavor and keeping quality of the milk; and to the very general inferiority of June

and July cheese in respect to keeping qualities, and the methods by which this defect may be in great measure overcome.

R. R. Stone, secretary of the association, speaking of the immense increase in the western demand said that, previous to 1860, with prices ranging from five to eight cents per pound, there was but little call for cheese, which now, notwithstanding the comparatively high prices, is almost as great a staple in the country groceries as tea, coffee, and sugar.

In the large dairy regions, associated producers and manufacturers have, at an early stage, appreciated the necessity of stringent regulations concerning milk delivered at factories. In March, 1869, the Illinois legislature, following the example set by the State of New York a few years ago, passed an "Act to protect butter and cheese manufacturers." This act forbids, under penalty of a fine of not less than $25, nor more than $100, the sale or supply to any cheese factory in the State of milk which has been diluted with water, or in any way adulterated, or from which any cream has been taken, or from which has been reserved any portion of the "strippings." A like penalty is to be enforced against the supply of milk that is tainted or partly sour.

The discussions at the sessions of the several associations bring out very clearly the great defects which exist in the average character of dairy animals in common use, and the necessity for more attention to the breeding and selection of stock as a means for securing more profitable returns. These representations by no means overrate the disadvantages to which dairymen are subjected by reason of inferior stock. Information communicated to this Department by the proprietors of a dairy of eight hundred cows, near St. Louis, shows an average daily yield, for each cow actually in milk, ranging from five quarts through November, to seven and two-third quarts in May and June—and this under liberal feeding. In the older States of the East, with convenient access to large markets, and under the force of long-continued competition, the average character of dairy-stock is raised to a higher standard, and the dairymen of Eastern Masssachusetts hold that a cow that does not average ten quarts per day through the greater part of the milking season should be fattened for the butcher. Yet, even in that region, great difficulty is experienced from the current methods of replenishing dairy stock by purchase from dealers who have themselves been obliged to collect from miscellaneous sources, whereby frequent disappointments occur in regard to the temper of the animal and the amount and quality of yield. One great requisite for the general improvement of dairy stock is, that the business of breeding for dairy purposes, as a specialty, should be extended far beyond its present limits. With proper care and skill this business must continue to be profitable, and should especially commend itself to agriculturists in those sections where land is cheap and good pasturage easily attainable. Only skillful and continuous experiment can fully determine the extent to which the improvement of dairy stock can be carried, but when a seven-eighths Jersey cow is found giving, for nine months, on no more than fair feed, a daily average of nearly nineteen quarts of superior quality, and for the entire year an average of seventeen quarts, it is safe to say that there is yet room for further improvement even in the well-managed dairies of Middlesex. There the dairy average is not more than ten quarts per day throughout the nine months, and the increase of nearly nine quarts per day would represent an increase of pecuniary profit, amounting to at least $90 for the nine months. While it cannot be expected that such a product will be attained in the ordinary course of dairy farming, it is evident that, with

better facilities for procuring approved stock, an increase might easily be made on present averages.

The action of the several dairymen's associations is developing a more general appreciation of the principles of breeding and of feeding—principles which are of great practical importance, even to the particular manufacture to which these associations are at present specially devoted, and for the permanent prosperity of which they are so energetically laboring. This prosperity they propose to secure by continuing the improvement which has been made in the quality of American cheese, thus maintaining and enlarging its reputation in foreign markets, and encouraging the increasing demands of the great home market, on which more than on any other field of consumption depends the profit of manufacture. The whole movement of dairy association affords to other branches of agricultural industry a most suggestive illustration of the beneficial results which flow from concerted and well-directed enterprise.

BUTTER MAKING.

Why is it that when superior butter brings twice the price of poor, there is so much that is decidedly unfit to eat? The art of making a good article has long been known, in all civilized countries, by thousands of people, still there is probably in no country a supply of the best for a tenth of the population. Some one recently asked, in the New York Farmers' Club, why plain directions for making good butter could not be published with a prospect for their general adoption. A veteran member replied, with something of human philosophy in the remark, that human nature was so perverse that few would follow any but the peculiar method early taught and long practiced. In many a city market a buyer of good taste may test the stock of a dozen stalls before finding one that offers a satisfactory sample; yet while the buyer honestly and properly says, "it is naught," the seller, perhaps, with equal honesty, declares it is "all right," either because it was made in his own family, or suits his own taste perverted with a thousand samples of poor or medium quality. So many a dairy-woman, proud of her achievements, sends her produce to market with first-rate expectations and receives in return a third-rate price. Yet while it may naturally differ, a really good roll or tub of solid, fragrant, sweet, golden butter will always find an appreciating purchaser and obtain a good price.

How can there be general improvement, approximation to perfection in quality, and avoidance of soap-grease bearing the misnomer "cooking butter?"

Hoping to lead to a practical solution of this problem, while despairing of offering anything actually new on the subject, we propose to give a view of the methods by which the most noted and acceptable butter of the country is made. It will be seen that methods vary, and that fine butter is made in many different ways, and yet it will be observed that there are certain principles which rule in all, and that there is really less difference than appears; and these very differences prove the possibility of general improvement and comparative uniformity by attention to essentials.

To find the first of these essentials it is necessary to go back to the pasture, and secure sweet and nutritious grasses, as milk and butter of the finest quality cannot be produced upon weeds, sour grasses, or distilled slops. Then the cows, selected for hereditary excellence as elaborators of superior milk, should be gently treated, carefully and rapidly milked by the same person at regular intervals. The milk and cream

must be kept at an even and comparatively low temperature, in a perfectly clean place, free from odors of every description; and the utenslis and vessels must be kept scrupulously clean, scalded thoroughly after use to prevent the development of cryptogamic germs; if in winter, milk and cream must not remain at so low a temperature, or be kept so long, as to become bitter. Then the butter, after churning, must be kept at a reduced temperature, worked thoroughly without much pressure in such a manner as to exhaust the buttermilk or added water, but not so as to break down the grain of the butter and render it greasy. Notwithstanding the fact that a very good article has been made by working with the hands, it is an uncleanly practice, not so well adapted to rapid and complete expulsion of buttermilk as approved mechanical appliances.

A study of the peculiarities of the modes of making the most popular brands of butter will reveal how fully the best practice agrees in the above essentials. We first describe the method adopted in making the

NEW YORK FACTORY BUTTER.

In the New York butter factories, the milk rooms are constructed with a view to thorough ventilation, and are provided with water tanks sunk in the earth, and arranged for a depth of eighteen inches of water. There should be a constant flow of water through the vats to secure a uniform temperature, which should not be below 48°, nor higher than 56°. As soon as the milk is delivered it is set in tin pails eight inches in diameter and twenty inches deep, the milk standing at a depth of seventeen inches in the pail. Milk cooled in this way throws up its cream rapidly, and the uniform temperature of the cream has a favorable effect on the churning. Good milk thus treated will keep sweet for thirty-six hours, even in the hottest weather, and as much cream may be obtained as from milk in shallow pans. The cream will nearly all rise in twenty-four hours, and should be taken off before the milk sours. The butter makers of Orange County prefer the old-fashioned dash churn, and add cold water in summer and warm in winter, at the rate of sixteen to thirty quarts of water to fifty quarts of cream. Thus the temperature of the cream in summer, when churning is commenced, is brought to about 60°, and in winter to about 63°. It is preferred that forty-five to sixty minutes be employed in churning. The butter, after being taken from the churn, is thoroughly washed in cold spring water, and after salting and working is allowed to stand a certain length of time, for instance, from morning till evening, when it is carefully packed in strongly hooped and perfectly tight oak tubs, and strong brine is poured in to fill intervening spaces.

THE PHILADELPHIA METHOD.

The description of the manufacture of the famous and costly "Philadelphia print" was given in detail in the Report of 1867. Great care, uniformity, and system characterize all its processes. The milking is done quietly and rapidly, the same milkmaid always attending to the same cows. The spring-house is usually of stone, on a side-hill, the floor covered with running water, and therefore always cool and free from odors. Deep tin pans, painted on the outside, with bails for handling, are filled to the depth of three inches, placed on an oak floor, and surrounded with cool, clear water of a temperature of 58°. The cream is taken off in twenty-four hours, kept in deep vessels holding twelve gallons, and stirred whenever a new skimming is added. A barrel churn is used, the churning lasting an hour, when a little cold milk is

added to cause the butter to gather. The buttermilk drawn off, ice-cold water is twice added, a few turns given to the churn each time, and the last water is scarcely colored with milk. A gentle rocking motion of the churn soon collects the butter, which is left two hours to drain off the remaining water through a small hole made for the purpose. The butter is worked by a corrugated wooden roller, revolving on a shaft supported over the center of the table, which also revolves under the roller. Beveled blocks at each end of the roller force the butter from the ends toward the center, so that the rolls are broken each time in fresh places. The roller does not quite touch the table, and there is no crushing of the particles, but a separation of the mass with a slight pressure which permits water or buttermilk to flow away. A cloth which has been wrung dry in cold spring water is repeatedly pressed upon the butter until not a particle of moisture is seen upon it as it comes from the roller, and the butter begins to adhere to the cloth. This is called "wiping" the butter. An ounce of salt to three pounds of butter is then thoroughly worked in by the aid of the same machine. Thus the processes are all conducted without any manipulation of the butter by the human hand. It is finally weighed out and put up in pound prints. One hundred pounds are churned in one hour and prepared for market in another, and deposited in tin trays and set in water to harden. The next morning it is wrapped in damp cloths, each pound by itself, put in a tin case upon wooden shelves, with two compartments of pounded ice to keep it cool, and surrounded by a thoroughly made cedar tub, it is sent to market and sold (often) at a dollar a pound.

VERMONT BUTTER.

The Green Mountains have been famous for good butter, and the best dairymen of that region keep the milk in cool, well ventilated cellars in summer, and in a sweet, clean milk-room at other seasons. The temperature desired is about 60°, and when it is reduced to 50° they scald the milk, and thus prevent bitterness, labor in churning, and loss of color. The milk is strained and set as soon as it is drawn, and skimmed before it becomes thick, generally in twenty-four hours when the temperature is up to 60°, but much longer in proportion as it is colder. Many prefer to stir the cream every twelve hours, and sprinkle over the top with fine salt. When the butter has "come," the buttermilk is drawn off and cold water or ice water turned in, and the butter thoroughly worked till rid of buttermilk; and if it is then "crumbly or spongy" the water is worked out by hand, very carefully, to prevent injuring the grain and rendering it greasy. David Goodall, in the St. Johnsbury Times, thus describes the mode of packing:

While the butter is warm, and as soon as salted, put it into the tub and pound it down solid; and, if it does not fill the tub, cover it with a cloth, and put on it a pint of brine. Fill the tub within one inch of the top; cut a cloth one inch larger than the butter and spread it on the top of it; then cut another cloth, one inch larger than the last, and fit it on the top, spreading evenly and turning up each edge on the inside of the staves; but it must not hang over, as it would draw brine out. Cut a bar of sweet wood, two inches by half an inch, and fit it on the butter; bore through the stave into each end of the bar, and put in a wooden pin tight to keep the bar in place; fill the tub with fine salt, and fill again with brine, and keep it full. Some put in one-fourth inch of fine salt at the bottom of the tub and cover with a cloth. I think the cloth without the salt sufficient.

PRACTICE IN OTHER NOTED DAIRIES.

S. Edwards Todd, of New York, after advising the milker to be care-

ful to enter upon his or her duties with clean hands, recommends the butter maker to "set the milk in an apartment as neat and sweet as a bee-hive; and, if possible, let the cooling breezes from the green hills pass in one window over the milk, and out at another window. As soon as a thick cream has risen, remove it, with as little milk as practicable; and the sooner the cream is churned the better the butter will be. Never allow the cream to rise in temperature above 64° F. If it can be kept at 60° the butter will be all the better for it. After churning, remove the butter with a clean ladle into a clean butter tray or worker, never touching it with the bare hands. Then, with the sharp edge of the ladle, make deep gashes all through the butter, and the buttermilk will flow into the gashes thus made; and when the gorge is thus closed, the liquid will flow away. After buttermilk has once been liberated by gashing the butter, it is not practicable to confine either water or buttermilk again in the butter. Neatness and proper temperature are fundamental requisites in making a choice quality of butter."

A correspondent of the New York Farmers' Club, writing from Adrian, Michigan, makes the following suggestions:

Set your milk where the wind will not blow on it, for the wind dries the cream, and dried cream will not make butter. In warm weather keep your cream still, for if you want your cream to become sour, stir it often. Very sour cream will not produce a good quality of butter. In cool or cold weather, don't think that you must let your milk set until it is sour before you take off the cream. Forty-eight hours is sufficient length of time for milk to produce all the cream it is capable of producing. In a right temperature it will rise in a less time. Much poor butter is the result of bad management of the cream. It is a good plan in warm weather to save strippings, about a quart, night and morning, from each cow, and churn every day. Churn your cream as cool as possible in warm weather. Much butter is spoiled by churning the cream too warm. If your butter comes rather warm, put in twice the salt you usually do, work your butter just enough to mix the salt well through it, and set it away in a cool place for twenty-four hours, then take it up and work it over. Much of the salt will be dissolved and will work out. Thoroughly cleanse your butter with salt. Use no cold water about your butter, for you cannot cleanse butter or any other lump of grease with water. Some women talk as though butter was not fit to eat unless it is first washed with cold water. If butter is not fit to eat without being washed with water, it is not by being washed. Water always damages butter. Butter that is washed with water is not fit to pack, for it will not keep. When the brine which oozes from your butter, as you work it, is clear, that is, clear from milk, it is worked enough; don't give it another stroke, except to get it into shape. Pack your butter in perfectly clean vessels, and keep it well covered with strong brine. When you use your butter, set it on the table just as you cut it out of the tub, for it is injured if worked after it has been packed. If all butter was made after this plan we would see but little that is poor.

At one of the meetings of the club of the Union County (New York) Agricultural Society, Mr. H. W. Garret, whose dairy product is represented as of excellent quality, gave in substance the following directions: Everything pertaining to the entire work of butter making should be kept scrupulously clean. Forty hours is the average period of time for a pan of milk to remain prior to skimming. It is necessary for the milk to sour before the entire cream can be obtained. If the atmosphere is such that the cream becomes rancid, immediately skim. Skimming at the proper time is absolutely necessary. The milk room should be kept at 61°. Twice a day stir the cream in the jars; let those jars stand in the coldest place in summer. When churning is necessary, let the cream be at 62°. Use a dash churn, which is superior to any other. When the globules are about breaking, reduce the temperature to 60°. Do not wash the butter. Work it as little as possible; too much working makes it salvy, and washing destroys the flavor.

THE BEST WESTERN MODE.

Western butter has not heretofore enjoyed a high reputation. It is possible that rank grasses and noxious plants may have been an element of this disrepute; impure water in some places may have had an influence; but the main cause has been a lack either of care or skill in the butter maker. It is rapidly improving, and while it commands a price less than that paid for New York butter, a considerable quantity is forwarded to the eastern seaboard, and some of it is of really superior character. It is probable that individual dairies may be found which produce an article unsurpassed by the best Orange County or Philadelphia products; yet these must be few compared with the aggregate number of western dairies. The intelligence, skill, and care evinced by many butter makers of the prairies will prove a leaven that may be expected to work wonders in the general improvement of the butter of that great section. The following directions for butter making, by Mrs. M. A. Deane, of Farina, Illinois, recently received a prize from the Messrs. Blanchard, churn makers at Concord, New Hampshire, as a model exposition of the subject and of general application:

Management of the milk.—The advantage gained during the hot season by the rapid and complete cooling of milk as soon as it comes from the cow can hardly be overestimated, as recent experiments show that the milk thus cooled will keep sweet much longer and yield its cream more readily and more abundantly; and as all experience has proved that the quantity of butter made depends greatly upon keeping the milk in such a state as to secure all the cream, a saving of labor is effected by this process, as the milk, when cooled to the required temperature, (60°,) may be set in deeper vessels, thus diminishing greatly the number of vessels required, and, consequently, the labor of cleansing them.

In a large dairy the washing and scalding of the shallow pans so much in use, is always a laborious and tedious process. There are many methods, more or less simple, for cooling milk. Patents have been granted for various plans, and many enterprising dairymen are testing ingenious devices of their own with excellent success. If it is not convenient to procure a cooler, the milk may be cooled by setting some large pails into a trough or box partly filled with very cold water, and pouring the milk into these pails as fast as it is drawn from the cows, allowing it to stand until of the required temperature—if necessary, renewing the water.

The pails used in milking should be of tin, never of wood. It is very difficult, almost impossible, to cleanse wooden pails so perfectly that they will not impart some degree of acidity to the milk, though it may be an insensible degree. Owing to this fact, some factories make it an absolute requisition that only tin pails shall be used by those who furnish them with milk.

The dairy room.—Much of the success of butter making depends upon the fitness of the place or room where the dairy is kept, and upon its condition as to cleanliness and freedom from taints and odors of every description. If a cellar is used, it should be a dry one, and perfectly clean to the remotest corners, having no hidden remnants of decayed vegetables or fruit, or anything which could possibly offend the most delicate olfactories. If a room in the dwelling house is used, or a milk house built separately, which is perhaps better, it should not be situated near a hog-pen, stable, or anything of the kind, nor should anything likely to impart its odor to the milk, as smoked ham, codfish, onions, or even potatoes, be allowed a place in the room. Nothing will receive a taint more easily than milk or cream; and all bad odors absorbed by the milk are certain to be concentrated in the butter, they not having the accommodating disposition to run off with the buttermilk. We have known butter to be spoiled in consequence of the milk standing in the room with a smoky furnace, and it is sometimes sensibly affected by the smoke of burnt grease and other unpleasant smells from the cook room. So if a milk room communicates with a kitchen the door should be kept closed.

Temperature.—The milk, whether in a cellar or in a room above ground, should be kept cool in the summer, never being allowed to reach a temperature above 60°, though it may fall below that without detriment. Milk should be set upon racks, rather than shelves, so that the air may circulate freely under it as well as over and around it. Racks are made in various ways; the most convenient that we know of is constructed as follows: Take a 6 by 6 pine post, of a length suited to the height of the room, place it upright upon a pivot so that it will revolve, and nail slats of half-inch stuff to each side of the post, at such intervals as will give room for the pans or other vessels used.

Two such slats, nailed to opposite sides of the post, will support two pans of milk, one on each side of the post. The rotary arrangement enables one to stand in the same place to skim a whole rack-full of milk. If pans are used, the seamless ones are best, but deeper vessels, either of tin or earthenware, are perhaps preferable, provided the milk is cooled before being set.

Washing the utensils.—The greatest care is requisite in cleansing these vessels, of whatever material or form, as also of all the other utensils employed in butter making. This is a matter of much greater importance than many suppose, as the smallest neglect in regard to it is sure to tell upon the cream and butter. The pans and pails should be washed thoroughly, in two waters, each time being made as clean as possible with the water used; they should then be scalded thoroughly with boiling water. It is not sufficient that the water should be tolerably hot—that it should steam in the kettle, or anything of the sort; it must "dance as well as sing." The churn, butter-bowl, and ladle, or butter-worker, if one is used, should be washed and scalded with equal care, and all should be carefully wiped and dried, unless some arrangement is made for drying in the sun, which will do very well for tin and earthenware, and save the labor of wiping. In summer it will be necessary to see that all utensils are cooled perfectly before using them.

Skimming.—The milk should be skimmed as soon as all the cream has risen, and before the milk has thickened. The exact time required for the cream to rise will, of course, depend upon the temperature; but a little experience will enable one to tell. At the time the cream should be removed it will have a bright, healthy appearance, a rich, yellow, uniform color, and such an adherency of particles as will enable one, sometimes, to remove the entire cream at one dip of the skimmer. If allowed to stand too long without skimming, both the quantity and quality of the cream will be seriously affected. The surface will become discolored, blotched, and knobby, while underneath, the cream is rapidly yielding to the corrosive tendency of the acid in the milk. The thickest cream may be as surely destroyed by standing on the milk as would be the firmest fabric in a bath of sulphuric acid. When thus destroyed, the cream is replaced by a thin, watery substance, having no resemblance to cream or milk. These facts, which may be easily verified, show how essential it is that the cream should be taken off before the milk has acquired any great degree of acidity. Yet, in order to make the largest quantity of butter, care must be taken not to remove the cream too soon. Many neat, thrifty housewives make a practice of "skimming up" all the milk at stated intervals, so as to be through with the job. This is, of course, very pleasant, but it involves considerable loss, as they do not get the full cream from the newest milk. The milk should all be skimmed at the same age, provided it has had the same conditions as regards temperature, &c. It follows, then, that some milk should be skimmed every night and morning.

Winter treatment.—It will be found that in winter milk and cream require somewhat different management. The effort must now be to keep the milk warm enough rather than to keep it cool; and a failure in this respect will very materially affect the quality of the butter. If the milk is very much too cold, it will have to stand so long for the cream to rise that it will become bitter often long before it becomes sour, and the quality of bitterness will be still more apparent in the butter. To prevent this, the milk should be kept at a temperature of 60° if possible; if not, the milk may be scalded as soon as strained, and the cream will then have a fair start before the milk has parted with this extra heat, unless the place where it is kept is very cold. If scalding is not found sufficient, two or three spoonfuls of sour milk (which has soured quickly and is not bitter) may be added to each pan of milk when it is set away. This will help to sour the milk and cause the cream to rise quicker, thus making it less liable to become bitter. It may also help to prevent bitterness to salt the cows often, and see that they do not eat decayed vegetables or any substances which may impart a bad taste to the milk.

The cream should be kept at about the same temperature, (60°,) and should be well stirred as often as new is added. It should not be kept too long before churning, never more than a week—four or five days is better.

Churning.—The cream should be churned at a temperature of 62° or 63°. A great deal of experience may enable one to guess at this temperature with tolerable cleverness, but it is better to use a thermometer and be sure. This temperature will be increased during the process of churning to 68° or thereabouts, when the butter will come. If it should be hard and granular, refusing to come together well, throw in a little warm water, churning all the while, and the butter will soon be gathered and ready to take up.

Sweet cream should never be mixed with sour cream just before churning, as sweet cream is much longer coming, and hence likely to lose itself in the buttermilk. To salt the cows once a week is generally believed to facilitate the process of churning. In case they have not been thus salted, some put a little salt into the cream before churning; but we think that in most instances where butter is very long coming, it is owing to the temperature of the cream. It may be so cold as to require churning all day to

bring the butter; a tax upon one's patience and strength, if performed by hand, equal to the cost of a dozen thermometers.

Coloring.—As a rule it is absolutely essential in the winter to color butter, in order to make it marketable, or at all attractive as an article of table use at home. There may be a possible exception to this rule in cases where cows are fed largely upon yellow corn meal, pumpkins, carrots, &c., but this does not lessen the importance of the rule. Of the various substances used in coloring butter, we think that carrots (of the deep yellow variety) give the most natural color and the most agreeable flavor. Annotto, however, is principally used, and with most satisfactory results. Some of the most celebrated butter makers in the country color their butter with pure annotto, giving it a rich, deep orange color. They do not aim to produce the color which is natural to summer butter, but one considerably richer; coloring it both summer and winter. If carrots are used, they should be grated, the juice expressed through a thin cloth, and put into the cream just before churning. A small quantity of annotto, dissolved in warm water or milk, may be used in the same way, and with similar results; but a richer tint is produced with annotto by coloring the butter directly. To prepare the annotto for this purpose, steep it in butter for some hours over a slow fire, then strain through a fine cloth into a jar and keep in a cool place. When ready to work the butter, melt a small quantity of this mixture and work it in carefully. A small proportion of turmeric is sometimes mixed with annotto and prepared in the same way. With this method of coloring, an inexperienced hand is in danger of working the butter too much, in the effort to produce the same shade of color through the entire mass, which is, indeed, a difficult attainment for a novice. Coloring in the cream obviates this difficulty entirely, the butter being of a uniform color when taken from the churn.

Salting and working.—While salt is not to be undervalued as a preserving agent, it must be remembered that too much of it destroys or overpowers the fine flavor and delicate aroma of the best butter. Be careful to preserve all the sweetnes of the fresh butter, salting just enough to remove its insipidity. It is important to use the best salt. "Ashton's factory filled" has great fame, and is extensively used. But any one can test the purity of salt, and perhaps other brands of Liverpool salt may be found equal to Ashton's. Pure salt is perfectly white and destitute of odor. It will dissolve in cold water without leaving any sediment or throwing any scum to the surface, and the brine will be as clear as pure water, and entirely free from any bitter taste. Professor Johnson says, in the American Agricultural Annual, 1868, that the "Onondaga factory filled must take rank second to none, provided the ingenious processes of Doctor Goessmann, which were employed in Syracuse a few years since, are still in use." The buttermilk should be nearly all worked out and the butter well washed before salting. Washing may abstract somewhat from the flavor of the butter, but it is, nevertheless, a necessity if the butter is expected to keep long, as it completely removes the cream and caseine of the buttermilk, a part of which might otherwise remain in the butter. Butter should stand but a short time after salting before it is worked enough to remove nearly all the water, when it may be resalted, if necessary; there should be sufficient salt left in the butter at this time to make a strong brine of the little water that remains. It may then stand until the next day, when it should be worked and packed. On no account should butter be allowed to stand long before working, as it is apt to become streaked, often so much so as to necessitate working over, in order to restore a uniform color. Besides, if neglected too long at this period a tendency to rancidity will be rapidly developed. We realize the difficulty of giving explicit directions for the second and last working of the butter—its final preparation for packing. If not worked enough, every one knows that the butter will soon spoil; if worked too much, it is spoiled already; though the danger of its being overworked is less. A great deal of judgment and discretion and somewhat of experience are requisite in order to determine when it is worked just enough; the virtue of stopping in this, as in many other cases, being second only to that of doing. There are some suggestions, however, which may prove valuable, particularly to those having little experience. 1st. The butter should not be too warm when worked, nor should it be so cold as to make working difficult. Immerse the ladle for a few minutes in boiling water, and cool perfectly in cold water; then, if the butter in the bowl is warm enough to admit of putting the ladle through the whole mass without difficulty, and dividing it up without crumbling, and still hard enough to cut clean and smooth, not the slightest particle adhering to the ladle, then it is in the right condition to work. 2d. It should be worked with careful and gentle, yet telling, *pressure*, and not by a series of indiscriminate stirrings and mashings and grindings against the sides of the bowl. The butter is composed of minute globules, which are crushed by this careless handling, thus rendering the butter greasy and sticky, whereas it should retain its clean, solid individuality up to the time of packing, always working clear from the bowl and never sticking in the least to the ladle. 3d. The butter should not be worked until it is perfectly dry. When ready to pack it should have a slight moisture about it, a sort of insensible remains of the clear brine which has been working off, and at

the last, enough, so that when a trier is thrust into it a drop or two of brine will ooze out around it, and the trier itself be slightly wet, as if by a slight dew. Overworking destroys all the beautiful consistency of the butter; makes it dry and sticky; greasy in summer, and tallowy in winter; gives it a dull appearance, and a tendency to become rancid. Altogether overworked butter is very disagreeable, if not positively bad.

Packing and marketing.—Butter should be packed solid, leaving no interstices of air, and should completely fill the firkin, tub, or pail, as the case may be, leaving a flat surface. It is common to put a cloth over the top and a layer of salt on the cloth. Some think it better to wet the salt, making a brine. The cover should then fit tightly, leaving no room for air between it and the butter. Some butter, also, goes into market in the form of rolls, some pine-apples, and other fancy forms for the table, &c. Every person should be guided by circumstances in his choice of styles for putting up butter, always being careful to give it a neat and attractive appearance. If living at a distance from market, and the dealers at his market place buy for New York, he should pack in firkins or tubs, so that the butter can be safely kept through the season, and the whole lot disposed of at once in the fall. If at a convenient distance from New York, fresh tubs or pails may be sent in at intervals all through the season, or the whole kept through, as he chooses; or, if in the vicinity of any city, good chances offer in the way of supplying hotels, restaurants, &c., the butter should be put up in a style to suit the customers. Some, who are hundreds of miles away, make shipments of butter to New York on their own account, instead of selling to buyers at home, in which case, if their butter is really superior, they will not be long in making a reputation, and will soon be able to secure a high price. Some few have a stamp of their own, and labor assiduously to establish a value for it, as a trade-mark. It is said that the best butter-maker in the vicinity of Philadelphia, (who never sells for less than a dollar per pound,) uses a stamp inherited from his father, and that "not a pound of inferior butter ever went to market with that stamp upon it." If you would attain to a goodly fame, then, as a butter-maker, and reap a rich reward for your pains, attend carefully to the minutest details in making, and never sell any but good butter, put up in neat packages; never allow your "trade-mark" to lose its value.

WINTER BUTTER.

There is much poor, pale, ill-flavored butter made in winter. There is, also, some produced of a fair average quality, only coming short of the fresh butter from the fragrant grasses of June. The difficulty lies partly in the winter food, and partly in the temperature of the milk. Willard says it should never be colder than 55°, and, at churning, the cream should be brought to 60° or 62°. If allowed to go above 65° the color and flavor are injured. It is liable to become bitter before the cream rises if the temperature is too low; and if it freezes the cream rises at once, but of poor quality, yielding white butter; if kept in a room heated by day and cold at night it will not rise well and is apt to be bitter and acid. It is not easy to secure a temperature sufficiently uniform. Some scald the milk when first drawn from the cow. A common English mode is to let it stand twelve hours, and then place the vessel containing it in a larger one, filled with boiling water, letting it stand twelve hours longer. Before churning, the cream-pot is placed before the fire, and its contents stirred occasionally to secure equal warmth, until a temperature of 55° is attained.

The Philadelphia dairymen find no difficulty in making good butter all winter. One, who obtains one dollar per pound, keeps the temperature of his milk-pantry at as near 55° as practicable. Butter comes harder as cows are advanced in gestation, and he likes to have fall cows so as to mix their milk with that of cows coming in in the spring. He finds clover hay, cut and moistened, sprinkled with meal and wheat shorts, the best food for making choice butter. As the food given makes a great difference in the flavor of the butter, it is important that no weeds be mixed with the hay. He thinks clover inferior to timothy or any other grass, and he does not feed cabbages or turnips on account of the flavor. Cows differ greatly in their qualities as butter

PLATE XXXIV.

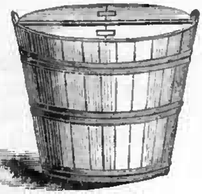


Fig. 1.

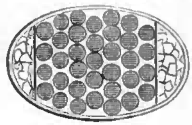


Fig. 2.

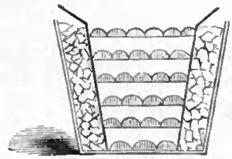


Fig. 3.

IMPROVED MARKET TUB.

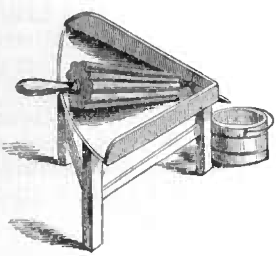


Fig. 4.

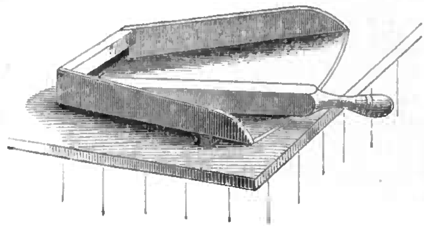


Fig. 5.

BUTTER WORKERS.

ORANGE COUNTY PAIL AND BARREL.

makers, and in selecting he finds it necessary to reject many animals that would be valuable in a milk or cheese dairy.

WHEY BUTTER.

Whey butter, produced to some extent in cheese factories, is made by two modes, the hot and the cold process. The hot process, originated by Riggs & Markham, of Lewis County, New York, requires a vat resembling the common cheese-vat, having a copper bottom, with tin sides, and in size twelve feet long by three feet wide and twenty inches deep. The dimensions are varied to suit circumstances, or according to the size of the dairy. The sides of the vat may be made of galvanized iron. The vat is set over a brick arch and arranged in a similar manner to arches used for making sugar. The flue is a slightly inclined plane toward the back end of the vat, so as to secure a more equal heat the whole length of the vat.

In the cold process, that of Killian Egger, a Swiss dairyman of Lowville, New York, the vessel for setting the whey is made of zinc, or with a zinc bottom. It is about fifteen inches high and three feet wide, and any length that will best accommodate the size of the dairy. The vat sets in a wooden vat, with a space between the two for cold water. The whey is run into the zinc vat, and for every twenty gallons, two handfuls of salt are added. During the first two hours the mass is stirred thoroughly from the bottom every fifteen minutes. It is then left to stand about twenty hours, when it is skimmed.

The churning differs little from the ordinary mode of churning cream from milk. The temperature must be kept at about 58°. As soon as the butter becomes granulated, it is left to stand about five minutes, and then the buttermilk is run off. Cold water is then thrown upon it to harden it.

THE WORKING OF BUTTER.

The universal testimony of good butter-makers establishes the fact that the least working of butter consistent with the expulsion of buttermilk, and the thorough incorporation of salt, are the requisites for superior quality. It is notorious that a large proportion of the market supply is overworked, the grain injured, leaving the mass greasy rather than granular. Butter of the finest possible quality is often reduced to an inferior grade by excessive manipulation. There are several kinds of butter workers; one much in use in the best Orange County dairies, of which a cut is herewith given, is described by Mr. Willard as a slab four feet long and twenty-five inches wide at the broadest part, tapering down to four or five inches at the lower end, where an opening allows the escape of the buttermilk, and a slat into which a long wooden lever fits loosely allows its free movement over the entire surface of the slab. It has beveled sides, the lever is either square or eight-sided, the butter is placed upon the slab and worked by pressing the lever down upon the successive portions of it till the whole is worked. It is not patented and may be easily made, the size varied to suit the convenience of different dairies. It is rinsed with cold water until the water runs off clear. It is then churned to gather it together, the water pressed out, when it is salted. The next day it is worked over and packed like other butter.

COMPARATIVE YIELD AND RICHNESS OF CREAM.

Another source of enlarged profit in butter making is found in the selection and breeding of cows. Some cows produce milk possessing

more of the oleaginous element than others, and therefore yielding more butter; others are superior for cheese making, by reason of the amount of caseine in the milk; the difference in quantity of milk is so great that one cow in the herd may be worth more than two others in the same herd. There are also other peculiarities of milk or cream that should be considered in its management and manufacture, as the length of time required to convert cream into butter. Mr. Sharpless, a Pennsylvania butter maker, has found by repeated experiment that the cream from milk of one of his cows will make butter in fifteen minutes, while that from another, fed in the same manner, will require twenty-five minutes. Mixing the cream of the two cows and churning fifteen minutes, he obtains butter; then taking out this butter and continuing to churn the buttermilk, he secures another batch of excellent butter. There is no doubt that much butter is lost in churning the cream of several cows, by this difference in the time required for churning.

Cows of small breeds yield more butter than those of large breeds, and the smaller individuals of a particular breed give richer milk than large specimens of the same breed. The larger animals and breeds, on the contrary, produce more cheese. A comparatively dry, and warm climate is favorable to the production of butter, and a cool, moist region conducive to a large yield of cheese. The evening's milk of cows at pasture is preferable for cheese; the morning's milk for butter, especially if the cows are stabled or yarded. Any annoyance producing nervous disturbance reduces the comparative quantity of butter in the milk secreted. Hurrying the herd from pasture, angry words or blows, troublesome flies, separation from the calf, periodical heat, and many other disturbing causes, all have this tendency.

The increased yield of butter in the dairy of Hon. Z. Pratt, in Greene County, New York, illustrates the value of persistent efforts for improvement. In 1859, a pound of butter required an average of 14.42 quarts of milk; in 1860, 11.20; and in 1861, 10.42 quarts.

While 600 gallons for the season, or two gallons on an average per day, may be all that a dairyman with a medium quality of cows may expect to obtain, the yield of the best milkers shows what might be accomplished by greater attention to breeding. Youatt estimates the daily yield of a good Ayrshire cow for the first month of milking at five gallons; for the next three months, three gallons; for the next four, one and a half—850 gallons during the year—but allowing for unproductive cows, he reduces the general average to 600 gallons, producing (at 9⅓ quarts for a pound of butter) 257 pounds of butter per annum, or 514 pounds of cheese. Many American dairies attain this average. Flint refers to a farmer in Western Massachusetts who for ten years made 500 pounds of cheese and 20 of butter per cow, and one year obtained 640 pounds of cheese and 20 of butter for each cow. The same authority mentions a single case of extraordinary yield, by an Ayrshire, of 511 pounds of butter. The famous Oakes cow of Massachusetts yielded in 1816 467¼ pounds of butter from May 15 to December 20, when she still gave eight quarts of milk daily. The weight of her milk in the height of the season was 44½ pounds. Yet this is not unprecedented, as many cows of the present time produce fifty pounds or more.

Andrew Cone, of East Bloomfield, Ontario County, New York, states that a cow of his in 1869 produced 400 pounds of butter in ten months and a half. She had no extra feed except green corn fodder when the pasture was short, and a few beets in winter. The pecuniary return was $180: butter, at 35 cents, $140; calf raised, $15; milk, $15; food for pigs, $10.

T. J. Bussey, of Macedon, New York, obtained in 1869, from a small dairy of four cows, 278 pounds of butter per cow, fed on grass only till November 23. Many farmers of New England and New York do equally well with well-bred or well-selected cows.

In Herkimer County, New York, where cheese is principally made, good dairies will easily average 600 pounds of cheese.

The cow "Lady Patterson," belonging to Colonel Thomas Fitch, of New London, Connecticut, was over twenty-four years old in November, 1869, and was to come in with calf the following month. She has had fifteen heifer calves in succession, of which all that have come to maturity have proved most excellent cows. Some of her heifers have sold for $300 to $400.. In the summer of 1860, when she was fifteen years old, N. Billings, of New London, who then owned her, tested her butter qualities for one week, and the result was 17 pounds 4 ounces of butter, besides the milk and cream used in the family, (in which were included three servants,) the cow having no feed besides good pasture. The mother of "Lady Patterson" was half Jersey and half Ayrshire; the sire, Jersey.

A gentleman writing from Boston, Massachusetts, states that his cow Sybil was ten years old in March, 1869, is seven-eighths Jersey and one eighth Ayrshire, with the appearance of a full-bred Jersey, is very handsome, has all the marks of a large milker, and weighs 950 pounds. She has always given a very large quantity of milk, and it has always been difficult to dry her for a few days before calving. She calved April 7, 1868, and again at date of August 14, 1869. A record kept of the milk given by her, commencing April 8, 1868, shows a yield of 13,065 pounds for one year, beginning with 55 pounds per day, and diminishing gradually to 20 pounds per day. Her food was poor upland pasture, helped out for six weeks with green corn fodder, about a bushel of grain in all, between grass and roots; and in winter, dry hay and one peck of roots (carrots and mangolds) per day. In July, on poor and dry pasture alone, she gave an average of 208 pounds of milk per week, from which were made 12½ pounds of butter. The average daily yield of milk for the year was 35.79 pounds, or 17 quarts. During the subsequent twelve weeks, viz, from April 8, 1869, to June 30, 1869, inclusive, she gave 1,574 pounds of milk.

Linus D. Sheldon, of Vernon, Ohio, writes as follows:

My favorite cow, Star, was ten years old last spring. She is a cross between the Holderness and the Durham. She calved Christmas eve, 1868, and I commenced weighing her milk on New Year's morning following. Her weight was then 1,590 pounds, and at the close of the year, 1,580 pounds. The yield per month during the year was as follows:

	Pounds.	Ounces.		Pounds.	Ounces.
January	1,147	12	August	881	..
February	1,038	14	September	900	..
March	1,079	12	October	887	..
April	1,001	8	November	575	..
May	1,148	12	December	339	..
June	1,152	8			
July	1,037	..	Total	11,118	2

The largest daily yield during the year was forty pounds; the last day she gave only nine pounds, within eight weeks of calving. In a previous year she gave during the month of June 1,207¾ pounds. She will come in the first of March next.

These recent examples show that the improvement of milch cows is not entirely neglected in this country, and indicate the profit of such efforts. It is probable that at least a million of the poorest of our cows would be dear as a gift to farmers entering upon dairy operations; and

it would be an easy matter, in the course of a few years, to increase the value of our present number of milch cows fifty millions of dollars, and not a very difficult undertaking to make the increased valuation one hundred millions.

COMPARATIVE PROFITS OF BUTTER-MAKING.

There are four ways of disposing of milk—for butter, cheese, condensed milk, and milk for family use. In the form of condensed milk, at prices hitherto obtained, its market value is highest, as a quart of milk, reduced to one-fourth its bulk in the vacuum pan, yields a little more than half a pound in weight, and realizes fifteen cents, at the rate of $3 50 per dozen for pound cans, one-third of which should be allowed for cans and manufacturing, leaving ten cents per quart for milk. The comparative profit of butter and cheese depends upon the prices, which fluctuate with the changes in both the local and general demand. As prices have ruled of late, it is believed that butter pays better than cheese. At fifteen cents for cheese, requiring fully four and a half quarts of milk to make a pound, and 45 cents for butter, requiring eleven quarts, the product, exclusive of cost of making, would yield four cents per quart in cheese, and four and a half in butter. Mr. X. A. Willard figures a still better result for the butter and skim cheese factories, where all the products of the milk are utilized. His statement of the yield of fourteen quarts of milk by this method, as compared with cheese-making, may be arranged as follows:

Cheese alone.		Butter and skim cheese.	
3 pounds cheese, at 15 cents	45 cents	1 pound butter	46 cents
Butter from whey	4 cents	2 pounds skim cheese	20 cents
Whey for swine	4 cents	Whey for hogs	4 cents
Average for butter in spring and fall	3 cents	Total	70 cents
Total	56 cents	Value of milk per quart, 5 cents.	
Value of milk per quart, 4 cents.			

As compared with the sale of milk, butter at 50 cents, or even at 45, yields a better net return, unless the market for milk is accessible and the dealers are willing to accept fair profits. This conclusion has been arrived at in the experience of many dairymen. At a recent meeting of the Farmers' Club at Brandywine Hundred, Delaware, the question was decided in favor of a butter dairy by a vote of 15 to 7. Statements of cash proceeds showed a range of $96 to $130 for each cow per annum for milk, and $100 to $150 per annum for butter. The great increase of cheese-making from one hundred and three millions of pounds in 1859, to the estimated product in 1869, of two hundred and forty millions, while the butter manufacture has only advanced from four hundred and sixty millions in 1859 to an assumed product of seven hundred millions in 1869, has tended to a comparative scarcity of butter. Not only has the foreign demand for our dairy products increased, but the home demand has increased much faster than the population. The home consumption of cheese is probably three times as large as in 1860, in the aggregate; the average consumed by each individual was then about two pounds, while now it is five.

The finest opening for profit in the conversion of milk is found in the manufacture of a superior quality of butter, like the "Philadelphia print," which will bring seventy-five cents to a dollar per pound, when

furnished in all its freshness and purity to appreciating customers, able to pay for it, while a fair article of tub butter is selling at thirty-five to fifty cents. There is a larger demand for such an article than butter-makers imagine, and the demand will be quickened by an increase of the supply.

It is practicable for producers of butter in the United States to increase its average price ten cents per pound, and this enhancement would put in their purses seventy millions of dollars! This is too large a sum to pay for ignorance, carelessness, and lack of cleanliness. This increase of profit is the more noticeable, as it is fair to assume that one-half the butter at present produced is so poor as to yield no real profit in its production.

MADISON COUNTY CATTLE SALES.

Monthly and quarterly sales, or "market fairs," as they are termed in England, have long been well established there, and are most popular and satisfactory—sale days on which the grazier, feeder, and seller bring their fattened animals, and the butcher comes to purchase his supplies, both at auction and on private terms; and, so far as we are advised, the system has gained in favor with both classes, until now many of the best dealers consider the plan invaluable.

Essentially the same idea was inaugurated in "the Kentucky blue-grass region," at Paris, many years since. A monthly court brought the planters and stock-men together, whence originated the idea of having at the same time a general sale and purchase of cattle, mules, horses, &c. Northern men here meet southern purchasers of mules and horses, including many brood mares, and thus are the cotton and sugar States enabled, in large part at least, to make purchases of such animals as meet their wants, and the North to dispose of her surplus stock at fair prices.

The plan usually pursued is to place the stock in the hands of some salesman to be sold at auction to the highest bidder. Quite a number of responsible men fill these positions, and the system is now thoroughly established. Hundreds of animals usually change owners on these "monthly court days," and each year adds to their importance.

Other communities have emulated the Paris plan and started similar enterprises; but from various causes, chiefly from want of system and energy on the part of the originators, these fairs have been allowed to decline, and finally have been discontinued altogether. The only other continuous similar success was originated about fifteen years since, by a few of the enterprising cattle-men of the "blue-grass region of Central Ohio." The call was issued in February, 1856, in pursuance of a programme previously arranged, whereby the cattle sellers and buyers of Madison County, Ohio, were invited to meet in the public square at London, Ohio; the former to bring their neat stock, which they desired to sell, and the latter to bring cash and their bids.

The sales for the first few months were not large; still a lively interest was manifested by both parties. The subjoined tables present a condensed statement of these sales from their commencement to the present time. A special qualification, however, should be made as to the exhibit for the year 1856, when the records were very imperfect. Probably fifteen hundred head of cattle were sold during that year, more than half of which were three and two year old steers. The prices of

that year will be found in the tables at the close of this article. From an examination of the tables, it will be seen that the numbers sold, and the prices obtained, have steadily increased, until now both sellers and buyers and stock-men who desire to keep advised of price, quality, and weights, attend these stock sales, not only from adjoining counties but from many other counties and States, including southern, eastern, and northern Ohio, from Indiana, Illinois, Kentucky, and often from States more remote.

For several years past a number of the regular furnishers have been purchasing, chiefly three and two year old steers, in the open markets of Chicago, St. Louis, Covington, and Cincinnati, and shipping their purchases monthly for sale, not only to the graziers and feeders of Madison, but to many of the larger feeders of the Scioto Valley.

The stock is generally sold by auctioneers, who receive a commission on sales, in the public square to the highest bidder, usually for cash, but sometimes on thirty days' time, or until the next sale day. Each owner of cattle looks after his stock, keeping it separate from that of others, and brings it in as opportunity offers, or as he may elect.

The sales usually open at about 11 o'clock, and from that hour until all are disposed of—usually 4 to 5 o'clock in the afternoon—the cries of half a dozen salesmen may be heard rapidly "knocking off" the lots placed in their hands for sale.

The salesmen have the cattle driven into the square, sellers and purchasers surrounding them; the auctioneer passes about constantly among those who desire to purchase, taking their bids, and either disposing of the animals or withdrawing them for the owner should prices not reach the required figures. Lots withdrawn in the morning are often brought in again later, and sold at an advance on former bids. The stock so offered consists of stock cattle, ready for grazing, or, in the later months of the year, for turning into "feeding lots" for "full feeding" for spring market, or put to grass for a better summer price.

The fat stock is not brought in for sale, but a very large number of cattle is sold, at an agreed price per hundred pounds, by the cattle-men to the shipping purchasers at the monthly meetings of stock-men.

It will be readily seen that most important advantages result, which are at least two-fold: first, sellers consult with each other, and obtain by such concert the best prices of the home market; second, shippers thus meet in a few hours those who desire to sell, and are enabled to purchase without personally visiting all at their farms, as was formerly the case. The risk of carrying large sums of money is also obviated, as the payments are all made by checks.

Within the past few years another feature has been added: horse buyers and shippers for eastern and southern markets are regularly obtaining desired supplies of all the various grades or qualities of drivers, street-car animals, and heavy dray or omnibus horses, as well as lower-priced animals and less valuable mares for the southern trade; all of which are brought in from the central counties of Ohio, and change hands quickly. This branch of the trade is almost universally carried on at private sale.

By this system of selling horses at home, any month in the year, farmers are enabled to economize much in the keeping of useless animals; during the corn season a large number are required, which are of no use to the grower, after July, until the next spring. At the early spring sales such extra horses as may be required, aside from the regular stock, can be purchased from persons having a surplus; many colts being taken and broken in this manner, which can be readily disposed

of as soon as the summer grain work is closed, thus reducing the expense of wintering—no inconsiderable item since grain, hay, and farm lands have advanced in value—and allowing the purchase of meat-producing animals to consume the provender hitherto fed to these horses.

Aside from these more important sales of neat stock and horses, other branches of trade have been satisfactorily added. Many sheep are annually fattened by the neighboring farmers, and are ready for market as soon as the wool can be clipped. Usually this trade is inaugurated by the first of April, sometimes in March. The feeders during February and March, generally at the sales of those months, meet the shippers and contract for their stock, agreeing on a time and place of delivery. During the months of June, July, and August, those who are engaged in wool-growing meet the buyers at these sales, whereby concert of action is obtained; prices are agreed on; sacks are taken out; and thus this most important business is satisfactorily done in a few hours.

The farmer and the farm hand meet here during the spring monthly sales, the first to engage, the latter to make contract for his summer work; each readily ascertains what his neighbors and friends are paying, and what those desiring to engage are receiving, and thus a standard of prices is more readily established than under the old plan. Contracts for the delivery of grain—of wheat, corn, oats, &c.—are also made between the grower and warehouseman or feeder; goods are purchased; taxes paid; deeds recorded; transfers of land made; and during the fall and winter months, nearly all the fattened hogs are sold for immediate or future delivery. The examination and purchase of agricultural machines, reapers and mowers, plows, harrows, and planters, are usually made on these "sale days." The manufacturers send their wares, and the husbandmen have opportunity for comparison of the different implements, and the benefit of the ideas and experience of their neighbors who may have previously purchased, thereby gaining a much more intelligent idea of the merits or defects of machinery than could otherwise be obtained.

All these specified results are but matter-of-fact adjuncts to these "Madison County stock sales" of Central Ohio, and form but a part of the advantages which thus inure to intelligent agriculturists and stockmen. In other sections of the country equally valuable results could be obtained were the grain growers, cotton and sugar planters, and others, to adopt and sustain similar sale days, at regular times, either monthly, quarterly, or as might be agreed upon.

The principal point is to establish, and by attendance encourage, such enterprises, making the sale and purchase of stock, of grain, of cotton, sugar, or tobacco, or of horticultural products, the main object, as may best accord with the taste or business of the originators.

In the establishment of such sale or market days as have been described, it is neither necessary nor politic to incur much outlay; first make the trial as near the centers of business, at a county seat, or city, open and free to all who may wish to attend, either from motives of curiosity, business, or pleasure, as can be arranged for. When the enterprise is firmly established it will be time enough to consider the acquisition of more convenient lots, or the erection of buildings, as the wants of the patrons may demand.

These suggestions of the economic inauguration of sale days are offered in view of the experience of some of the counties of Ohio, where the people have attempted to institute such an enterprise. They first incurred heavy expense in the arrangement of lots and the construc-

tion of sheds, for the use of which a fee was charged the seller, in some cases more than commensurate with the resulting advantages; hence the enterprises, at first promising, soon became unpopular, and were early discontinued.

To give an idea of the sales made, the prices obtained, and the weights of the various ages and kinds of cattle, horses, sheep, and hogs that have changed ownership at the monthly sales in Madison County since their establishment in 1856, we append tables showing the annual averages from that date. Since the establishment of these sales the taxable valuation of all the neat stock of Madison County has increased, until now the average assessment is $40 57 per head; while the total average of the whole State last year was but $21 79 per head. The average for horses is about equal to the average for the whole State, about $70 per head. For sheep the average is $2 26 per head, while the general average for the State was but $1 93. Hogs show a corresponding improvement the average valuation being $4 37 per head; while the average for the State was $3 45.

It would, perhaps, be unreasonable to ascribe all these favorable results to the influence of these sales, still it is believed that much of the superiority in these stock branches is due to this enterprise.

The business done in connection with, and as a result of, these sales days would, were a showing made, amount to many hundreds of thousands of dollars. Business men of every class—dealers in dry goods, hardware, and agricultural implements, manufacturers and agents, grain and produce dealers, grocers, indeed men in every branch of business—unite in keeping up the interest, value, and importance of this coming together of sellers and buyers. Aside from the successful accomplishment of a large business, and the very great convenience and economy to seller and purchaser, the means of dissemination of news, prices, supplies, and the views of experienced stockmen and farmers are always valuable. The advantage of social contact is one of the most important considerations, and presents an additional argument in favor of the establishment of similar stock or market sale days in other counties, districts, and States of the Union. This record refers only to stock, mainly to cattle.

The following tables, prepared by Irving F. Willis, of London, Madison County, from whom the above suggestions have been received, illustrate the constant trade since the inauguration of this system of sales:

A recapitulation of Madison County, Ohio, stock sales from their inauguration, March 8, 1856, to July 1, 1869, showing the numbers sold of each age and kind, so far as recorded.

Years.	CATTLE.													OTHER STOCK.					Remarks.
	Three years.	Two years.	One year.	Total of three, two, and one year.	Calves.	Oxen, yokes.	Milch cows & calves.	Dry and fat cows.	Heifers, three years.	Heifers, two years.	Heifers, one year.	Bulls.	Total number of cattle.	Horses.	Mules.	Sheep.	Hogs.	Total of stock of all kinds.	
1856, 10 months	430	360	....	790	....	50	20	60	15	30	25	....	990	....	....	....	....	990	Not all reported.
1857, 12 months	970	1,630	1,110	3,710	2	48	16	10	....	....	....	10	3,796	52	4	852	28	4,732	Do.
1858, 12 months	318	1,267	661	2,246	....	13	34	34	....	....	....	....	2,327	55	37	690	57	3,166	Do.
1859, 12 months	936	1,433	806	3,175	14	37	40	20	....	....	....	2	3,288	53	72	271	....	3,684	Do.
1860, 12 months	1,071	1,264	906	3,241	19	102	24	41	....	....	....	3	3,430	37	....	177	28	3,672	Do.
1861, 12 months	543	922	702	2,167	24	33	28	5	....	....	....	6	2,268	....	14	315	40	2,637	Do.
1862, 10 months	1,061	996	949	3,006	44	29	28	92	....	....	....	....	3,129	....	....	300	15	3,444	November and December not included.
1863, 10 months	699	802	198	1,699	13	40	17	124	....	....	....	3	1,896	....	....	1,047	....	2,943	No sales in July and October.
1864, 11 months	259	732	273	1,264	18	104	31	64	....	....	....	2	1,483	....	....	237	....	1,720	Times dull.
1865, 11 months	413	805	262	1,480	64	78	37	73	....	....	....	4	1,736	15	76	225	....	2,052	No sale in July.
1866, 12 months	709	940	520	2,169	32	62	47	103	....	57	17	5	2,492	26	47	228	76	2,869	Reports not complete.
1867, 12 months	643	1,664	632	2,939	10	86	46	193	....	21	29	3	3,327	....	23	236	....	3,586	Do.
1868, 11 months	960	2,247	793	4,000	65	65	48	89	3	29	12	8	4,319	151	14	1,030	15	5,529	No sale in September. Cattle plague.
1869, first six months	734	807	465	2,006	99	30	59	21	....	12	3	....	2,230	421	....	....	....	2,651	
Total of 153 sales	9,746	15,869	8,277	33,892	404	782	475	859	18	149	86	46	36,711	810	287	5,608	259	43,675	
Average per year	731	1,190	621	2,542	30	59	36	64	....	....	....	....	2,753	61	21	421	19	3,275	
Average per sale	64	104	54	222	....	....	....	....	....	....	....	....	240	....	....	....	....	285	

A great many, often fifty per cent., of the sales made were on private terms, and therefore are not recorded here. In the beginning, reports were imperfectly taken.

A recapitulation of Madison County, Ohio, stock sales, showing the average weights and average prices of the different ages of cattle, &c., so far as recorded.

Years.	CATTLE.																
	Three years.	Three years.	Two years.	Two years.	One year.	One year.	Average of three, two, and one year.	Average of three, two, and one year.	Calves.	Calves.	Yokes of oxen.	Yokes of oxen.	Milch cows and calves.	Milch cows and calves.	Dry and fat cows.
	Pounds.	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*
1856, 10 months	....	$37 75	....	$[illegible]0 00	....	....	....	$29 21	....	....	....	$107 80	....	$40 00	....
1857, 12 months	....	34 80	....	24 04	....	$16 40	....	24 56	....	$27 00	....	105 68	....	26 56	....
1858, 12 months	1,100	33 63	913	23 15	620	14 41	853	22 06	350	8 85	2,488	85 00	950	25 65	1,150
1859, 12 months	1,137	35 02	913	23 19	640	15 84	909	24 81	350	8 85	2,488	90 84	1,400	26 77	1,150
1860, 12 months	1,016	29 65	870	24 86	654	17 46	858	24 37	267	9 05	2,584	84 48	1,093	24 28	1,052
1861, 12 months	1,037	25 62	872	20 06	601	13 90	826	19 46	350	5 18	2,610	72 75	1,016	21 62	1,214
1862, 10 months	1,031	25 60	772	16 33	586	12 06	805	18 25	392	6 26	2,445	66 03	1,025	19 81	1,021
1863, 10 months	1,021	38 06	808	19 52	609	13 17	872	28 41	370	6 39	2,350	78 46	975	18 17	826
1864, 11 months	997	41 23	768	27 50	611	16 75	793	27 99	400	10 09	2,911	133 04	1,000	33 50	1,100
1865, 11 months	942	45 86	817	36 77	639	24 44	820	37 12	500	15 16	2,475	162 83	1,000	45 00	1,017
1866, 12 months	1,175	72 91	927	51 84	665	34 36	945	54 54	450	27 54	2,720	175 39	1,000	53 17	1,015
1867, 12 months	1,129	71 40	902	48 54	594	29 50	885	49 45	475	28 75	2,704	186 44	950	52 26	972
1868, 11 months	1,095	68 01	840	43 14	585	27 15	851	45 94	412	15 80	2,432	175 10	901	46 58	930
1869, first 6 months	1,132	73 32	842	44 74	592	28 30	908	51 39	394	20 90	2,441	162 05	888	48 57	974
Average from January 1, 1858, to July 1, 1869	1,078	46 64	862	32 90	616	20 11	863	33 68	409	15 41	2,603	132 44	1,008	38 05	984
Average since 1864, when prices began to advance	1,118	68 13	866	45 20	609	29 04	880	48 07	433	19 39	2,572	173 99	942	49 24	980

Recapitulation of Madison County, Ohio, stock sales, &c.—Continued.

Years.	CATTLE.									OTHER STOCK.				Estimated total cash sales.	Average cash sales per month.
	Dry and fat cows.	Heifers, three years.	Heifers, three years.	Heifers, two years.	Heifers, two years.	Heifers, one year.	Heifers, one year.	Bulls.	Bulls.	Horses.	Mules.	Sheep.	Hogs.		
	Price.	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Pounds.*	*Price.*	*Price.*	*Price.*	*Price.*	*Price.*		
1856, 10 months			$17 50						$75 00					$60,000	$6,000
1857, 12 months					$20 60		$16 00		58 33	$99 90	$120 00	$3 00	$6 00	172,000	14,333
1858, 12 months	$24 00				22 03		15 00		47 00	83 19	99 57	1 06	5 48	77,250	6,438
1859, 12 months	24 00				22 03		15 00		47 00	91 88	74 75	1 81		125,500	10,458
1860, 12 months	26 25							1,300	41 83	72 10		1 76	5 19	96,000	8,000
1861, 12 months	26 00							1,112	33 90		64 00	1 96	4 30	48,000	4,000
1862, 10 months	24 88											2 41	2 15	60,000	6,000
1863, 10 months	19 55							1,300	29 50			3 51		50,000	5,000
1864, 11 months	27 00							1,150	27 25			3 91		50,000	4,545
1865, 11 months	39 89							850	31 00	80 00	78 00	4 11		82,000	7,455
1866, 12 months	53 75			850	40 40	650	33 00	950	39 32	63 33	94 63	2 65	10 55	156,000	13,000
1867, 12 months	39 74			732	32 71	528	17 60	1,200	49 25		65 00	2 65		180,000	15,000
1868, 11 months	38 84	766	39 92	584	22 96	575	18 87	950	36 50	141 67	96 00	3 46	12 50	227,000	20,636
1869, first 6 months	45 89			695	33 38	450	15 65			126 67				166,000	27,667
Average from January 1, 1858, to July 1, 1869	35 16							1,062	36 84	118 31	82 14	2 77	7 15	114,587	10,050
Average since 1864, when prices began to advance	42 87			749	34 08	567	22 05	968	38 01	126 54	83 02	3 33	10 87	180,222	15,596

Estimated total cash sales from March 8, 1856, to July 1, 1869	$1,549,750
Average per year of cash sales from March 8, 1856, to July 1, 1869	116,231
Average for each sale cash sales from March 8, 1856, to July 1, 1869	10,129

A FEW FACTS IN SHEEP HUSBANDRY.

The present tariff upon wool and woolens has been a balance-wheel which has proved an efficient regulator of the business of sheep husbandry, saving it from present ruin and a future of slow recovery. The decline in wool in all foreign countries, which has reacted so powerfully upon the business in this country, would otherwise have resulted in irreparable injury to the wool interest, and subsequent damage to other farm industries. As it is, despondency has wrought abandonment of the business in many cases, and wool growers, except a few of greater wisdom and foresight than others, have been upon the verge of panic.

The reduction in prices has been naturally followed by neglect, and neglect as surely by disease and pecuniary loss. Foot-rot has disseminated itself; migrating flocks have introduced the scab into new fields; and millions have been left to shift for themselves, amid the storms of winter, because hay and grain were too dear for transformation into wool. Losses have thus accumulated, and thousands of flock-masters have quit the business in disgust. Great numbers have communicated statements to this Department, that were evidently facts, showing receipts smaller than actual expenditures. There is no doubt that with these drawbacks, a part inevitable and a part resulting from neglect and mismanagement, the business, as a whole, has been less remunerative for four years past than some others in which agriculturists have been engaged. Yet, amid all this discouragement, undoubted facts appear showing that in individual cases profits have been made during all this period, by good management, attention to mutton rather than wool in populous regions, and judicious adaptation to altered circumstances in other respects.

THE AMERICAN MERINO.

The American Merino still maintains its superiority over all other sheep, of this or other countries, as a wool-bearing animal merely. The character of the wool, for strength, length of fiber, and a medium fineness, for which there is by far a greater demand than for either extra-fine or for coarser qualities, is superior; and the proportion of wool to live weight is unsurpassed by any other breed. As improved in recent years by Mr. Hammond, and many other noted breeders, in form, size, and weight of fleece, the original Spanish importations have been so modified as to entitle the breed to the distinctive appellation which it now bears, as fully as in the cases of the French and Silesian improvements. Our correspondent in Addison County, Vermont, the heart of the American Merino region, thus compares the old with the new:

The heaviest fleeces shorn by Mr. Atwood, of Connecticut, twenty-five years since, were 5 pounds from ewes, 5 to 8 from rams. Now, 18 pounds are taken from best ewes, and 26 to 30 from best rams, the growth of twelve months. The Child Brothers, of Weybridge, bred several years from a ram that sheared as follows: First fleece, 16 pounds; live weight, after shearing, 64 pounds; second fleece, 24 pounds; live weight 99 pounds; third fleece, 26 pounds; live weight 107 pounds. Although these fleeces are very heavy they do not injure the vitality of the sheep, and the keep that will fix a wether nicely for market will keep the Merino in fine condition. Of course fleeces of the above weight will shrink in cleansing more than the light wools; yet no other breed of sheep has yet been produced that, in proportion to live weight, will produce three-fourths as much cleansed wool per head as the Merino. Between 8 and 9 pounds have been realized in numerous instances from a single fleece.

To show that some men still find a profit in wool-growing, the following extract from returns of our correspondent in Fulton County, Ohio, is given, though his estimate of profit must not be taken as net profit after allowance for interest on capital, for personal superintendence, &c.:

My own flock of 1,000 head (with 45 head of cattle and horses) is kept on about 200

acres of cleared land (meadow, pasture, and plow land) and 400 acres of open woodland pasture. I feed from 150 to 175 tons hay, without grain or roots. The yield of wool averages $3\frac{1}{4}$ to $3\frac{3}{4}$ pounds clean washed wool; breed, one-half to three-fourths Merino. I keep them, in summer, in flocks of 200; in winter, 100 to 150. My losses average from 5 to 8 per cent.; increase, 10 to 15 per cent. My last clip I sold at 50 cents, (recently,) and the clip of 1868 sold in Boston for 50 to 55 cents, according to grade.

It takes about 10 tons of hay to winter 100 sheep, worth $6 to $8 per ton; but fed upon the farm to sheep at $5, it is more profitable than at $6 to $8 carted to market. I estimate the entire cost of keeping sheep at 80 cents per head per annum. The increase, in almost any event, will keep the flock full in numbers. I estimate, from the best data I can get, that the net profit in fine wool sheep in this county is from 33 to 40 per cent. Long-wool sheep are equally profitable, but cannot be kept in so large flocks.

E. D. Battles, of Mayfield, Cuyahoga County, Ohio, makes the following statement:

For the last eight years, including 1862 and 1869, I have kept from 300 to 400 of the long-stapled Spanish Merino sheep. The average weight of fleece for eight years was four and three-quarters pounds. The wool was sold annually at an average price of 60 cents per pound.

The increase of the flock over and above the loss was 25 per cent. After the flock was increased to 400 (commenced with 300) it was kept at that number by selling the three years' old wethers, dry ewes, and drafting from the remainder of the flock such as were thought to be of the least profit to keep. The sheep that were sold brought, on an average, $3 per head. The annual proceeds of each 100 sheep were—

From wool	$285 00
From increase	75 00
Total	360 00

The average annual expense of 100 sheep for the last eight years has been as follows:

Hay consumed in 125 days, 10 tons	$100 00
For 240 days' pasturing, at 3 cents per head per week	103 00
For grain	30 00
Washing, shearing, and taking wool to market	20 00
Summer and winter care, including salt	30 00
Total	283 00

Profits on 100 sheep, over and above all expenses, $77.

Mr. Battles lives in the eastern portion of Cuyahoga County, about fifteen miles from any railroad. Land, hay, pasturage, &c., is cheaper there than in any other portion of the county.

The following statement shows the cost and profits in keeping 70 ewes, 20 lambs, and 20 rams, the Merino flock of C. A. Miller, Marshall, Calhoun County, Michigan.

Fifteen tons of hay, at $8	$120 00	
Labor in feeding	20 00	
Pasture	67 00	
Washing and shearing	10 80	
Salt and summer care	8 00	
Total		$225 80
Wool of ewes, 652 pounds	$253 28	
Wool of rams, 285 pounds	76 95	
Letting of rams	100 00	
30 lambs sold, at $3	90 00	
20 choice lambs kept	60 00	
Manure	50 00	
Total		630 23
Profit		404 43

A wool-grower in Livingston County, Missouri, reports a flock of 500 Merinos, purchased at $780, which at the end of the year he sold for the same amount, after selling their wool for $500 and keeping a handsome young flock from the increase. Another flock of 500 ewes, in Benton County, costing $1 50 each, had 200 lambs, of which 190 died, destroying all profit for the year 1869.

Our correspondent in Washtenaw County, Michigan, reports that four brothers by the name of Wood, on Lodi Plains, in that county, keep about 150 to 160 each of Merino sheep, and obtain an average clip per head of about 7 pounds washed wool, and that by careful management they have increased their yield about one half pound per head each year. Their annual income from sale of fine-wooled sheep and the clip of wool has been about $2,000 each for five or six years past. They only keep fine-wooled sheep.

The mountain districts of the South have the finest sheep ranges, almost entirely unoccupied, on which grass sufficient for millions of sheep annually decays, of no immediate advantage, and of no remote benefit except as a fertilizer of the soil. Merino sheep would thrive upon this herbage, and wherever the experiment has been fairly tried great profit has resulted. They also do well upon the lowlands of the South, if they escape the ravages of dogs and vagrants. As an example: In Pulaski County, Georgia, Mr. A. bought 800 head of sheep, in 1868, of which the following statement is made:

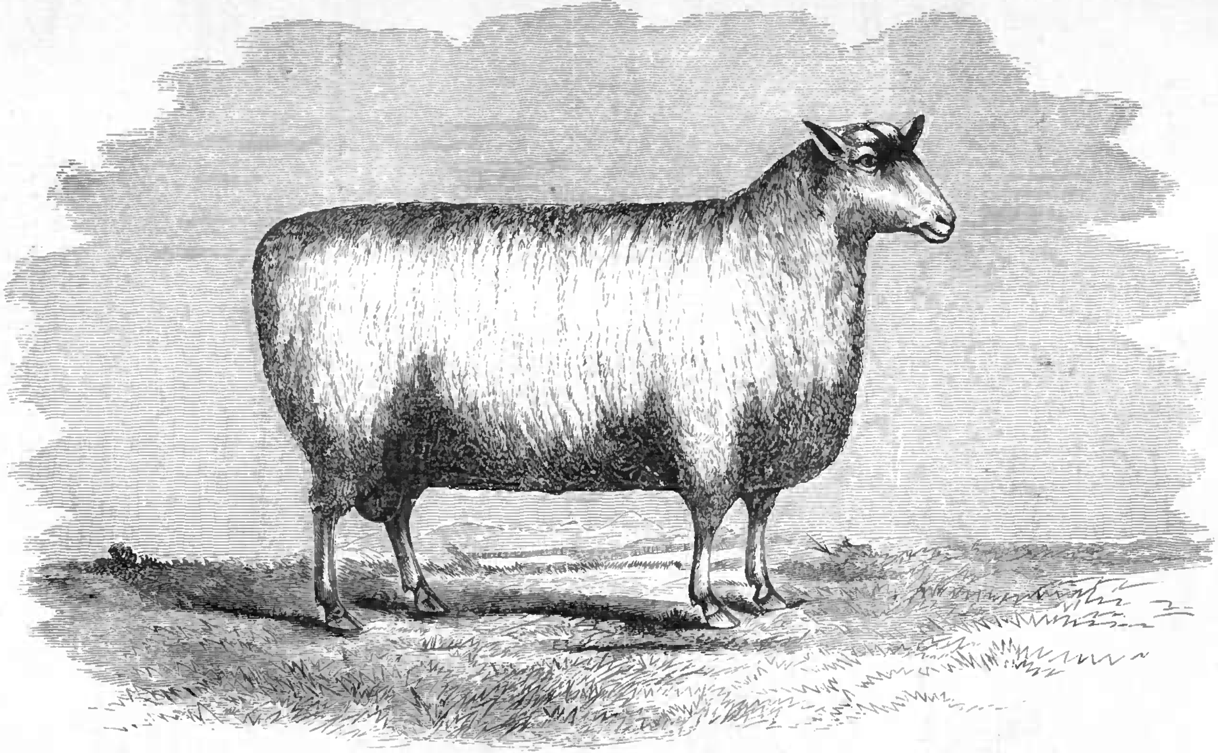
DR.		
Cost	$750 00	
Cost of one hand to care for them, $12 to $15 per month	180 00	
Salting and incidental expenses	20 00	
		$950 00
CR.		
2,000 pounds wool, at 30 cents	600 00	
Increase, 225 lambs at $1	225 00	
15 acres of land well manured, at $10 per acre	150 00	
700 sheep on hand, $1 50 per head	1,050 00	
		2,025 00
Profit		1,075 00

This was the scrub stock of the "piney wood" counties of Georgia, but serves to illustrate the profits of sheep raising even in that State. Pasturage costs nothing. Good stock would pay better.

S. F. Christian, of Bandera, Texas, sends the following tabulation, compiled with the aid of records from actual experience in wool-growing, with a flock of selected grade Merinos improved by thorough-bred Merino rams. The annual increase, allowing for losses of lambs, is placed at 80 per cent., half males, which are sold annually, and the ewes added to the flock:

Years.	Breeding ewes, number annually.	Ann'l increase of ewe lambs.	Ann'l increase of ram lambs.	Yearlings transferred.	Yearling wethers sold.	Price per head, at which sold.	Amount in dollars received for wethers.	Annual clip of wool in pounds, at the rate of four pou'ds per head.	Cash received for wool at 25 cts. per pound, gold.	Annual aggregate expense for labor.	Incidental for salt, tar, medicine, &c.
1	1,200	480	480					4,800	$1,200	$600	$60
2	1,200	480	480	480	480	$1 25	$600	8,640	2,160	900	90
3	1,680	672	672	480	480	1 25	600	10,560	2,640	1,200	120
4	2,160	864	864	672	672	1 25	840	14,016	3,504	1,500	150
5	2,832	1,132	1,132	864	864	1 25	1,080	18,240	4,560	1,800	180

PLATE XXXV.



LEICESTER RAM.

At the close of the fifth year the value of the flock is estimated:

Breeding ewes, 2,832, at $4	$11,328 00
Lambs, ewes and rams, 2,264, at $1	2,264 00
	13,592 00
Stock rams, 86 head, at $25 per head	2,150 00
Total value of entire stock	15,742 00

A correspondent in Independence County, Arkansas, expresses his surprise that sheep are actually killed in Indiana and Ohio to get them out of the way, when thousands might be sold in Arkansas, and tens of thousands find abundant pasturage on its hills and mountains in winter as well as in summer.

The following extracts from correspondence of this Department gives some idea of the condition of wool-growing in California:

Mendocino County.—I generally keep from 1,200 to 2,000 head. They were originally from Ohio; have been crossed with French and Spanish Merino bucks till now; their wool is much improved in quantity and quality; the cost of keeping is about 50 cents a head, and the returns, 60 to 75 cents from wool, and their increase; about 80 per cent. would be considered a good increase of the breeding flock in ordinary seasons. The losses on breeding ewes during the year, in ordinary seasons, will be about five per cent. The wethers are always sold off to the butchers. Lambs are usually worth from $1 to $1 50 when about three months old. My sheep are never housed or fed more than they get on the range, except the bucks at breeding time.

Stanislaus County.—The lambing season is now fully over and spring shearing has commenced. The percentage of lambs in this county varies from 8 to 130 increase, adding from 70,000 to 75,000 to the old flocks.

A laboring man in my neighborhood, who had saved $1,200 in the last few years, purchased 600 head of second-rate ewes at $2 per head last summer. This spring he has 600 lambs, and his spring crop of wool averages 2½ pounds per sheep.

The flocks owned in this county are mostly grade Merinos, raised for mutton as well as wool; few or none are full blood. The fall and spring clip of wool will always more than pay the cost of keeping the flock, and the interest on land when it belongs to the individual.

Yuba County.—The expense of wool-growing is only a herder to a flock, whether of 500, 800, 1,000, or up to 4,000, whose wages are about $25 to $30 per month. This state of things cannot last long, as the inclosures, farms, and grain fields are encroaching upon the sheep ranges.

THE MUTTON BREEDS.

The difference in price, in our principal markets, between juicy, tender, quickly-grown and well-fattened mutton and lamb, and the tough, skinny, and indigestible carcasses which produce what is aptly denominated "sheep meat," is sufficiently wide to enforce an argument for better mutton. The depression in wool has directed attention to breeds most in request for mutton, and to the enlarged production of fine spring lambs. Letters from all the States east of the Mississippi indicate a growing preference for the mutton breeds. The Cotswold is generally preferred in the West, on account of its good size and constitution, and length and quality of wool. In Kentucky the Lincolns, of great size and lustrous wool, are regarded as quite suitable for depasturing the luxuriant blue grass. In the Atlantic States, where early lambs are raised, Southdown rams upon selected grade Merino ewes are used with much satisfaction. Some of the most experienced feeders, for fat mutton, prefer the Leicester, as first of all in early maturity and amount of flesh put on for the food consumed. The numbers of all these breeds are increasing, and they must eventually predominate throughout the level, fertile, highly improved areas of our country, while the Merino will hold sway

among the mountains, the great grassy plains, the unoccupied forest pastures of the South, and the dry hills of New Mexico and the Pacific slopes. A few facts gleaned from official correspondence will illustrate the comparative profit of the coarse wools, and serve to indicate the extent and range of the preference accorded to them.

Mr. C. E. Plumb, Trumbull, Fairfield County, Connecticut, reports a flock of 36 breeding ewes, 20 ewe lambs, and 2 stock rams, Southdowns, bred from Webb rams for fifteen years. His flock averages three lambs to every two ewes; is pastured in summer without folding; yarded in a well-littered lot in winter days, and housed in a warm and well-ventilated barn in storms and winter nights; is fed regularly three times per day with hay, a pint of dry oats to each, and turnips *ad libitum* at mid-day; and yielded last year an average of $4\frac{3}{4}$ pounds of wool for ewes, and $7\frac{1}{2}$ pounds for rams, selling at 42 cents. The breeding ewes sell readily at $25 each; lambs at $25, after the choice is retained. The flock has never been attacked by contagious or malignant diseases.

The sheep of New Jersey, as a rule, are bought and sold annually. In August ewes selected for thriftiness and adaptation for breeding are purchased from drovers coming from Ohio and elsewhere, at from $3 to $6 per head. They are pastured in the early autumn; served usually by Southdown rams; fed during the winter; their clips sold in the spring; their lambs sold early at $4 to $8 per head; and the ewes fattened quickly and disposed of for mutton, in June. Thus within ten months from purchase the cost is returned in wool, lambs, and sheep, and from $6 to $10 per head obtained for feed and care, besides a quantity of valuable manure; and farmers find a profit in this business, notwithstanding the low prices of wool. The following examples, from actual records of this practice in Gloucester County, may be taken as representative statements:

1869, April.	Received for lambs	$101 00
1869, May.	Received for sheep	98 70
1869, June.	Received for sheep	72 00
		271 70
1868, August 1.	Cost of 25 sheep	75 00
	Net receipts	196 70

1869, April and May.	Received for lambs	$110 50
1869, April and May.	Received for sheep	90 00
		200 50
1868, August.	Cost of 18 ewes	63 00
	Net receipts	137 50

A Delaware County, Pa., correspondent writes that a large number of the farmers of that locality winter from fifteen to sixty ewes, mainly for the lambs, wool being a secondary consideration. Lamb-crosses from a Southdown ram and common ewes are thought to be as profitable stock as can be raised, some flocks realizing 200 per cent. on the original cost, and sold within a year from the time of purchase. The smaller the flock, the better the percentage of profit, all other things being equal.

In Maryland and Virginia, the preference is strong for coarse-wooled sheep. They are also popular and profitable further south, as illustrated by the following extract:

Barnwell County, S. C.—This section is admirably adapted to sheep husbandry. Last

year my flock of grades (Cotswolds and Southdowns) paid over 100 per cent. per annum with wool alone. Average clip of "piney woods" (unimproved) flock, 4 pounds per fleece. I exhibited a fleece from a Merino buck at our last county fair, weighing 16½ pounds. No feed required during the entire winter, the woods and old fields furnishing abundant croppings. When it has been necessary, from any cause, to fold and feed sheep, I have found cotton-seed to be all the food they require. There is more money to be made (in proportion to investment) by sheep husbandry in this State than by any other department of rural economy.

A Mr. Wright, of Northumberland County, Virginia, purchased 68 sheep in the fall of 1868, at $3 per head. He turned them on a wheat stubble seeded to clover; they had no other food or care. They produced over 100 lambs, which he sold last May for $5 per head, netting him nearly $300 above the original cost, besides the original stock and the wool on hand.

Our correspondent in York County, Virginia, writes as follows:

My own flock consists of 100 ewes, common native stock, bred to the Southdown rams. I raise about 80 lambs, worth here, in June, about $4 each. The wool about pays cost of keeping the flock. I consider the profit on the flock 100 per cent. The benefit to the land from the sheep eating down the weeds, briers, and sprouts, and from their manure, is equal to the interest on cost of land.

Our correspondent in Clarke County, Virginia, thus gives his views and experience with different breeds:

It is far more profitable to keep the different varieties of the mutton breeds than the fine wools or Merino breed in this portion of Virginia. I say this from my own experience and that of many intelligent gentlemen with whom I have conversed. The Cotswold sheep and its crosses with the Southdown are less liable to diseases of all kinds; they are more prolific, better nurses, and less liable to lose their lambs than the Merino. The lambs are more vigorous and hardy; then add their early maturity, their fitness for market at 18 months old, and their almost-double value when in market, and you have advantages which far outweigh the additional amount of food which the mutton sheep may consume, in proportion to his size. I have said nothing about the difference in the value of the wool, because I believe there is very little difference; if there is any, it is in favor of the mutton breed in this county. In January, 1869, I agreed to take from a gentleman in this county 100 Spanish Merino ewes to keep on the shares—he giving me one-half of the lambs and one-half of the wool—for keeping them until the fall of 1869. They were put in a field of 75 acres sod, with 45 acres of woodland attached; the pasture was good, and they fattened upon it. At the same time, 25 ewes of Cotswold and Southdown were put in the field; the Merinos, in the spring, produced 56 lambs; the 25 Cotswold and Southdown ewes raised 24 lambs. The feed was the same, and the same care was bestowed upon each flock, for they were together all the time. All the Merino lambs were sold in October, 1869, at $2 per head, except five, which had the foot-rot so badly, they could not be driven to market; the Cotswold and Southdown would have brought double the money per head. These views apply to this county, which is only fifty miles from Washington, D. C., and about eighty-five miles from Baltimore.

Prince George County, Maryland.—Sheep need no shelter here except what woods or open sheds or tobacco houses afford. Seldom any grain is given them. My flock is small but choice. They have had this winter no grain, no hay, and no shelter, and are fat and healthy, with well-grown fat lambs of different ages, from ten days to two weeks old. They have run all the time on an old clover and timothy pasture, grazed close last autumn, except when the ground was frozen or covered with snow, when they had access to the rye field, where the fodder shocks stand. Most of them are Southdowns, a few have a crop of Cotswolds. They will shear an average of over six pounds of wool, and have lambs living now in the proportion of six lambs to eight ewes, although some have been killed by dogs.

Mr. A. T. Drane, of Shelby County, Kentucky, who was engaged in breeding Cotswolds, from 1850 to 1866, without intermixture, has been crossing them with Lincolns, and as yet has had no occasion to regret his action. It is a fine grass region, such as the heavy breeds delight in, and the climate appears to be congenial, sheep being proverbially healthy. They thrive upon grass exclusively, appearing to desire no other feed, when it can be had, and getting no grain except at yeaning time. Mr. D. thus writes concerning them:

They usually have one lamb at a birth, but have twins about often enough to make

up for losses, and save about one lamb to the ewe bred. They are remarkably good nurses. Their fleeces are heavy, long, and lustrous, and command the best prices for combing. I sell rams chiefly, seldom sell ewes, and without attempting to state what it will cost to keep a sheep a year, or to tell how many may be kept on an acre of grass, I will merely give a glimpse at the record of my flock in 1869, and let the reader make his own deductions: From 80 sheep—

Sold 848 pounds wool in grease for	$364 62
Sold sheep during the year for	638 00
Rent of one ram	100 00
	1,102 62

I now have on hand 83 head of sheep, and my flock has yielded a gross return of $13 78 each, with a gain of three sheep.

Carroll County, Kentucky.—The sheep most profitable in our county are the Cotswold and their grades. They will consume probably one-fourth more food than the fine wool sheep, but are hardy, needing no shelter, and generally live the entire winter on our blue grass pastures without other food, produce from 6 to 10 pounds of wool per head, and from 60 to 100 pounds good mutton at one and two years old. I have about 50 in my flock of the Cotswold and grades which I have taken as a sample for the above statement. They have not eaten a single pound of hay or anything but what they have gathered for themselves in the pasture, winter or summer, for the last two years. This wool is worth, just as it comes from the sheep, unwashed, 35 cents per pound; mutton is worth 10 cents.

Scott County, Kentucky.—George S. Barber has a flock of pure bred Cotswolds—keeping about 40 ewes for breeding. They have grass the whole year, and in cold or stormy weather are fed some corn and oats, and are housed in very bad stormy weather, and cost in keeping the year about $10 per head, having extra care and attention. His flock clips, on an average, 10 pounds combing wool, and raises on an average one lamb to the ewe. He sells his entire surplus to breeders in this and other States, at prices ranging from $25 to $100 per head, according to age and selection. He procures every two years an imported or Canada buck, at a cost of about $100, for his own breeding. He breeds his lambs at eighteen months old.

At a meeting of the Farmers' Club in Cuyahoga County, Ohio, Mr. Flick, of Warrensville, expressed his opinion that Ohio could not compete with Texas in wool production, although mutton might be marketed at a profit, and confirmed it with a bit of personal experience. He purchased 35 good common grade Cotswold ewes, which cost $52, and a buck, $35. These produced 37 early lambs, born late in February and early in March. These lambs, with the exception of six which he retained for further experiments, he sold to the butchers in June, realizing from them $151. The ewes sheared an average of four pounds per fleece, and the wool sold for $60 20. In September, having fitted his ewes for mutton, he sold them for $87 50. Total proceeds from the 35 ewes, $298 70. Deducting the cost of ewes and lambs, $87, and interest of money invested, &c., he found the net proceeds to be $205.

Mr. Saunders, of Winnebago County, Illinois, writes:

"I keep a flock of about 400 of my own raising; they are crosses of English mutton breed and Merino. Have always made them profitable. The lowest price obtained during the last four years was, for a lot of thirty, sold just after shearing in summer of 1868, at $4 75 each, being the culls of a lot of 125 fed last winter; the balance were sold early in March, 1869, at $7 20, with the wool on. My surplus of last year I sold at $6 45 each, early in December, 1869. They were fed on grain about thirty days.

"I consider it pays quite as well to raise and fatten mutton sheep as it does to raise steers for beef. Cost of keeping my store sheep this winter, about $1 25 per head, or 100 bushels corn at 50 cents per bushel, and ten tons of hay at $5 per ton per 100 sheep. Twenty-five cents per head will pay for taking care of them, and the manure for a year is worth more than their pasture in summer."

Mr. A. F. Allen, of Gilmantown, Buffalo County, Wisconsin, has had for the last six years an average flock of 150 Southdowns and Leicesters; he calls his sheep worth $2 50 per head, and shears from 4 to $4\frac{1}{2}$ pounds on an average. He sells his wool at 30 cents a pound, and the mutton sheep at $4 per head; estimates the cost of keeping at $1 per head; calculates the wool to give him a profit of about 20 cents per head, and

that he can keep up his stock and sell thirty mutton sheep a year, at $4 each, making a profit of about $1 per head. He says the coarse wooled sheep are easier kept, hardier in this climate, better breeders, and better mutton.

McLeod County, Minnesota.—Leicester and Cotswold are more profitable, the sheep being hardy and valuable for mutton. One man bought a flock of coarse-wooled sheep. They were in poor condition. He fed them well on hay and some refuse grain, kept them one year and has sold enough for mutton to pay the original price of the flock, and has about the same number on hand that he purchased. The wool has paid the expense of feed.

MR. WINNE'S EXPERIENCE IN FEEDING.

Jurian Winne, of Bethlehem Center, Albany County, New York, one of the vice-presidents of the Agricultural Society of that State, whose operations in sheep feeding for mutton are profitable to himself and instructive to others, thus gives the result of his experience in the winter of 1869–'70, which is less satisfactory than usual, because his agents purchased less carefully and cheaply than he would himself have done, and also on account of delay in marketing from heavy snows of spring:

COST.

December 1, 1869:		
585 coarse-wooled sheep, including pasture to date (hired) and freight, $8 20 per head	$4,797 00	
Deduct proceeds of 140 sheep sold at this date, average weight 130 pounds at 8½ cents	1,547 00	
Leaves cost of 445 sheep		$3,250 00
February 14, 1870:		
180 fine-wooled sheep, weighing 18,580 pounds, $7 56 per 100 pounds	1,404 65	
Freight, feed, &c	20 00	
		1,424 65
Total first cost		4,674 65
1,245 bushels corn	1,245 00	
8 tons mill feed	204 00	
300 bushels oats	150 00	
134 bushels peas and oats	71 32	
60 bushels barley	42 00	
Oil meal	76 12	
40 tons hay, (cost)	320 00	
Salt	20 00	
Attendance, 1 man	120 00	
Expense of marketing	61 12	
		2,309 56
Total cost		6,984 21

SALES.

April 7, 1870:		
247 coarse-wooled sheep, weighing 37,860 pounds, at 9¼ cents net	3,502 05	
April 14, 1870:		
184 coarse-wooled sheep, weighing 28,320 pounds, at 9½ cents	2,690 40	
180 fine-wooled sheep, 19,730 pounds, at 9⅛ cents net	1,800 36	
2 sheep with lambs retained, value	20 00	
8 sheep butchered, value	85 00	
4 sheep lost, died	-----	
Total sales		8,097 81
Gross profit, besides manure		1,113 60
Deduct interest, estimated as equal to 7 months' interest on $5,000		204 17
Net profit, besides manure		909 43

This is $1 19 per head for 765 sheep, or deducting those sold before feeding, $1 46 per head for 625 sheep. The 180 fine wooled sheep were fed fifty-nine days, and gained in weight 1,150 pounds or $6\frac{7}{18}$ pounds per head; they cost $1,424 65 and sold for $1,800 36, and make a gross increase in value of $375 71, or $2 47 per head. The 247 coarse wooled sheep sold April 7, were fed one hundred and twenty-seven days, and 184 were fed one hundred and thirty-four days; average, one hundred and thirty days. The gain in weight cannot be given. The increase in value was $2,909 27, or $6 75 per head.

The coarse wooled were bought in Canada, in autumn; the fine wooled at West Albany, in dull market in February, and their gain of $2 47 with a gain in weight of less than 6½ pounds, per head, shows that the profit was due to advance in price rather than improvement in flesh. The Canada sheep average 153½ pounds when sold; the Merinos, 109½ pounds.

Mr. Winne has long been a breeder of Leicester sheep from the finest imported stock. He finds them peaceable, not inclined to ramble, very docile and quiet in the yard; good nurses, their lambs healthy and requiring little attention. He also considers them easy keepers, consuming little more than fine wools of half their wool weight—a conclusion arrived at by accurate and repeated experiments in feeding. But their most desirable quality, in his view, is their early maturity, by which he can "turn quickly" his money, represented by grain and hay of high price fed to them. He claims that he can mature a Leicester as easily at eighteen to twenty months old as he can Merinos or large coarse wools at two and one-half years, and make it weigh 160 to 280 pounds, live weight, and dress from 85 to 150 pounds of mutton.

The ram represented in the accompanying engraving was bred by Mr. Winne, from a flock in which the blood of Colonel Talbot's importation is mingled skillfully with that of the importations of Messrs. Brodie, Hungerford, and Converse, and is regarded by him as the best yearling ever bred in that county. At eighteen months he weighed 289 pounds.

The cost of keeping his breeders is about $5 per head; they shear from 6 to 13 pounds per head of washed wool, worth, at present prices, 65 cents per pound. The ram lambs bring from $18 to $25 per head; ewe lambs, $15 to $20; breeding ewes from $20 to $50; yearling rams from $80 to $100; two-year olds from $40 to $100.

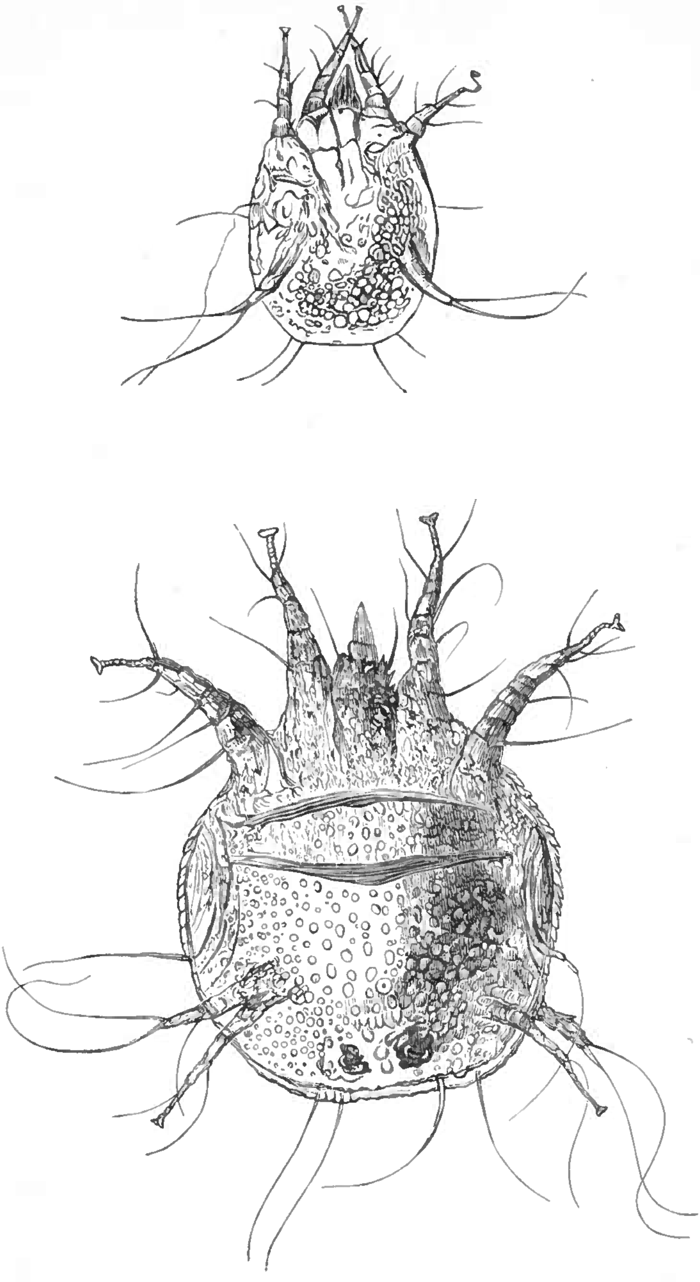
THE ACARUS OF SHEEP-SCAB.

The general prevalence of scab in this country gives importance to a brief examination of this subject.

The scab of sheep, like scabies, the itch of man, is caused by an insect. The mange affecting the horse, ox, dog, and cat, also depends upon the presence of insects. There are different insects, known as *acari*, infesting different animals, having destructive characteristics in each, and generally confined to that species of animals, yet the mange from a dog is said to have been communicated to man, and a horse has been infested with mange by means of the skin of a mangy cat.

The sheep acarus does not bore galleries in the skin, but remains on the surface, clinging to the wool, and finding shelter among the masses of scab produced by the drying of exudations from the wounds inflicted by these parasites. Experiment has shown that increase of temperature hastens the hatching of their ova; fourteen days, according to Professor Brown, of England, sufficed to hatch a lot in a bottle "carried in the trowsers pocket," while two months' time was required with some kept under glass in a room. The young have six legs; the fully grown, after several changes of skin, have eight. The microscope re-

PLATE XXXVI.



ACARUS OF SHEEP SCAB.

veals sucking-caps or disks in the legs, enabling the parasite to cling to the wool and skin of the sheep; and renders beautifully apparent the action of these structures, showing, as the feet advance, how the disks are expanded to grasp the surface of the substance over which the acarus is moving, apparently retaining their hold in obedience to the volition of the animal. Thus its structure adapts it for crawling over and adhering to the skin, instead of burrowing beneath it. Burrowing acari, like the itch insect in man, are always armed with cutting teeth, set in strong jaws, and their legs are very short. The body of the female of the sheep acarus is larger than that of the male, rounder in form, the fourth pair of legs are developed nearly as well as the third, and are supplied with terminal sucking disks. The accompanying illustration represents a female acarus magnified one hundred diameters, and a young six-legged acarus, also magnified one hundred diameters. Mature mites are visible to the naked eye as pellucid points of the size of a pin's head.

Various experiments have been made to ascertain the rapidity of the growth and reproduction of these parasites. The young acari have been detected in fourteen days from the direct transference of the acarus to the skin of the sheep. In a month the disease had spread over a space of five inches; in ten to twelve weeks pretty nearly over the whole body. A greater or less amount of time may be required under different circumstances of temperature, and other modifying influences.

Symptoms.—The first sign of the existence of scab is rubbing against any projecting body within reach; as it extends, sheep bite themselves, kick with their hind feet at their sides and shoulders. If one is caught and the hand placed on the mouth, while infected parts are scratched, gratification is evinced by nibbling at the hand, and when the infection is severe or general this nibbling movement is regarded as an infallible sign. Examination will disclose spots on the skin, white and hard, the center marked with yellow points of exudation, which adheres to the wool, matting the fibers together. The wool may be firm on these spots, and no scabs are seen at this stage. Then the yellow moisture, evaporating, gives place to a yellow scab, which adheres firmly to the skin and wool. Raw places appear at points which the animal can reach with his teeth and hind feet. The disease is complicated in summer by the presence of the larvæ of the blow-fly, the maggots burrowing under the scab. The animal becomes nervous, excited to wildness, and cannot obtain properly either food or rest, thus losing flesh and becoming reduced to a skeleton, from constant irritation and lack of nutrition, only the strongest animals recovering if left without treatment.

Remedies.—Destruction of the parasite and its eggs is the only object of remedial treatment. Arsenic and mercury are often employed very effectually, but they are poisonous, and therefore injurious and dangerous to the sheep. These and other solutions are used both as washes and dips. Sudden changes of weather and locality, or a deficiency of food after such treatment, often induce serious or fatal results which cannot be guarded against. Whole flocks have thus been lost. Mercurial ointment, with olive oil and a little turpentine, is popular in England, nevertheless, and is regarded as improving the yield of wool. Experiment proves that the acarus will live in arsenic and sulphur for some hours; potash is more fatal, and tobacco is more deadly still, killing in a few minutes. But carbolic acid is probably the most potent remedy used. When combined with one hundred times its bulk of water, it has killed acari in two minutes; when used with fifty times its bulk of water, a degree of potency harmless as a dip, it kills in forty to

ninety seconds. Professor Brown thus describes the manufacture of the carbolic acid dip, which, it is claimed, has never failed when properly used:

First, it is necessary that carbolic acid should be obtained of uniform strength, and experience has proved that the crystalline product is less efficacious in the destruction of parasites than the liquid residue, which is sold under the name of terebane, or cresylic acid, which can always be obtained of the manufacturers. The liquid is, when fresh, of a very light straw color, becoming dark brown on exposure to the atmosphere. The pure carbolic acid was employed in many experiments, at first with only partial success, but even had it proved to be superior to the liquid terebane, the price would have been a serious objection; terebane, however, is very much cheaper, and in every experiment was found to be more active as a remedial agent than the pure carbolic acid, while its fluid condition at all temperatures renders it more easy of manipulation.

To effect perfect combination between the terebane and the water used for dilution care is essential, as imperfect mixtures are capable of doing injury, and may cause the death of some of the sheep, particularly of those which are first introduced into the bath. The reason of this is obvious. An incomplete mixture allows the separation of the terebane, which floats on the surface of the fluid in the form of a brownish oily, or rather tarry scum; the first few animals which are dipped become covered with the undiluted acid, which acts at once and energetically as a caustic, causing prostration and death, unless immediately on observing the symptoms of distress means are taken to wash off the agent with warm water and soap; this treatment is not, however, at all times successful.

An accident of the kind never ought to occur, and, in fact, never can occur if the dip is properly prepared and used. It is scarcely probable that agriculturists will attempt to make the compound, and the following directions, therefore, may be taken as meant for the instruction of the practical chemist or the veterinary surgeon who has charge of the diseased flock:

A quantity of terebane, proportioned to the number of sheep to be dipped, is to be placed in a convenient vessel of iron or earthenware, and, if possible, the vessel should be suspended in a larger one containing water, and so arranged that heat can be applied. In all chemical laboratories a water-bath will be available; but for the purpose of making small quantities of the dip, an iron bucket suspended in an ordinary copper filled with water, which may be kept hot, but not up to the boiling point, will answer perfectly well. As soon as the terebane is placed in the temporary water-bath, a certain proportion of soap, one bar weighing over two pounds to each gallon of terebane, is to be added. The mixture should be stirred with a wooden rod until the soap is entirely dissolved, care being taken that the fluid does not boil. When the solution is complete the compound should be removed from the fire, and as soon as it ceases to give off vapor, oil of turpentine is to be added in the proportion of one pint to each gallon of terebane The mixture, when cold, may be poured into carboys or casks ready for use.

While the above remedies may be entirely efficacious, and are to be recommended as the best, it may not be amiss to give a few which have been popular heretofore:

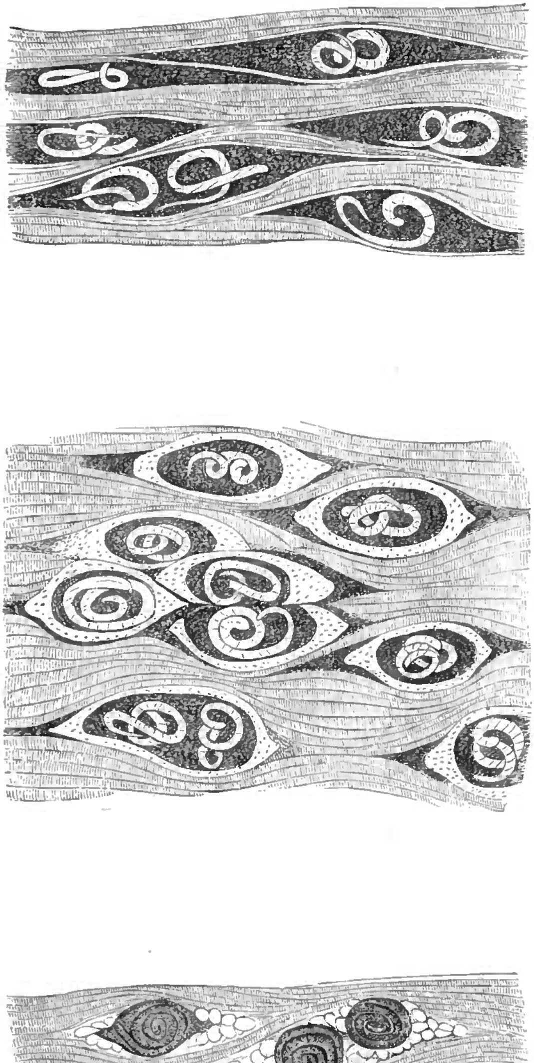
An infusion of arsenic, half a pound of the mineral to twelve gallons of water. The sheep should be washed in soap-suds and then dipped in the infusion. This treatment is preferred by Mr. Spooner.

Mercurial ointment, incorporated thoroughly with four times its weight of lard, rubbed upon the head and upon the skin (the wool being carefully parted) in parallel lines from head to tail, four inches apart. The mixture applied should not exceed two ounces, and a half an ounce may be enough for a lamb. A light second application is sometimes necessary. Preferred by Mr. Youatt.

One pound of sulphur gradually mixed with half a pound of oil of tar, the mixture rubbed down with two pounds of lard, may be applied in the same way. Mr. Randall would prefer this, because not poisonous, if sure to be effectual.

Another mixture contains a half pound of corrosive sublimate, three-fourths pound of white hellebore, six gallons whale oil, two pounds rosin, and two of tallow. This is powerful, and should be sparingly applied. Tobacco decoctions are much used in this country and quite effectually, if thoroughly applied after the wool is taken off.

PLATE XXXVII.



TRICHINA SPIRALIS.

A correspondent in New York, who did not succeed with the tobacco wash, effects cures with a mixture (well rubbed in) of one ounce subcarbonate of potash, two ounces lac sulphur, one ounce oil of tar, and one pint of whale oil.

Chancellor Livingston found the following a specific: A decoction of tobacco, one-third as much lye of wood ashes, with as much lard as the lye would dissolve, a small quantity of tar, with one-eighth of the whole by measure of the spirits of turpentine, applied, after rubbing hard with a shoe-brush to break down the scabs, by rubbing the parts affected, two or three times, at intervals of three days.

TRICHINA SPIRALIS.

The subject of parasitic diseases is one on which most persons have very few definite ideas. Every one when young has been dosed with vermifuges, and has grown up with the vague idea that mankind is liable to the presence of intestinal worms. Occasionally a tape-worm excites the wonder, curiosity, and serio-comic horror of a neighborhood; but very few are aware of the wonderful variety of parasitic animals, or of the painful and serious affections to which they often give rise.

Parasites live and subsist upon or within animals, plants, and man kind. There are both animal and vegetable parasites; and plants, animals, and men have varieties peculiar to themselves, and diseases arising from them. The mistletoe is a vegetable parasite of another plant, generally the oak; ringworm is caused by a vegetable parasitic growth, which affects the hair; lice and intestinal worms are animal parasites, which infest other animals.

It has been thoroughly proved that some of these parasitic diseases, both animal and vegetable, can be, and often are, communicated from animals to man and from man to animals. It is also possible that, as Dr. Aitken says, "the blights of plants, or the causes of them, are communicable to animals or to man. We know that some of the diseases of man and animals are intimately related to famines and unwholesome food, and that famines are due more to diseases of vegetable and animal life than to destruction or loss of food." In view of all that is known and is probable regarding their nature, extent, and influence, parasites and parasitic diseases claim and deserve much more attention than they have heretofore received from the majority of people.

Those affecting man and animals have been made the subject of special investigation by many profound, laborious, and sagacious students. They live either on some surface or within some cavity of the body, and from this circumstance animal parasites have been divided into entozoa and epizoa, and vegetable parasites into entophyta and epiphyta. There are many subdivisions which it is unnecessary to mention, and of the whole number those entozoa occupying the tissues or cavities of the bodies of man and the domestic animals are, perhaps, the most important.

Of these Dr. Cobbold enumerates at least thirty-one distinct species in man alone, some extremely common, and others very rarely found; some attacking the muscular and subcutaneous parts; some the eye; some residing in the alimentary canal, others in the more vital organs, such as the liver, brain, heart, and lungs. Iceland is afflicted by one variety of the tape-worm, (*Tœnia echinococcus,*) and the Russian Cossacks

suffer from another, (*Tænia mediocanellata;*) the Guinea worm (*Dracunculus medinensis*) flourishes in the tropical and semi-tropical parts of Asia and Africa; the long tape-worm (*Tænia solium*) is found in Great Britain, and the broad tape-worm (*Bothriocephalus latus*) on the continent of Europe, and both to some extent this side the Atlantic; while the *Ascarides* find a habitation in infantile intestines from Sweden to Melbourne and San Francisco. Some enter the body with the water imbibed; others with the food eaten. One species of fluke (*Fasciola hepatica*) is found in the liver of the sheep, causing the immensely destructive disease popularly known as the "rot;" another (*Distoma lanceolatum*) is derived from the liver of the ox, and the broad tape-worm, heretofore referred to, from the flesh of the same animal; while the long tape-worm, also previously mentioned, results from the consumption of "measly" pork.

The development and migration of parasites demand here some notice, which must necessarily be of the most general character. The sexually mature entozoa are found in those parts of the body which have free communication with the external air, the lungs, alimentary canal, and bladder; but in their immature condition they are to be found in the substance of the tissues, glands, and other organs—parts of the body not having such communication.

These early forms of the entozoa do not become fully developed in their first habitation, but must migrate or be carried into cavities of other individuals to obtain their maturity; though some kinds become mature in a free state, in water, mud, or on moist vegetation.

Herbivorous animals probably obtain their parasites from the grass and water they consume; carnivorous animals from the flesh of their victims. From many experiments made on animals by Kuchenmeister, Moquin-Tandon, Von Seibold, Leuckart, and others, it has been discovered that the tape-worm of the dog (*Tænia serrata*) is the sexually mature form of the encysted parasite of the rabbit and hare, (*Cysticercus pisiformis,*) as well as of that of domestic cattle, (*Cysticercus tenuicollis,*) of the hog, (*Cysticercus cellulosæ,*) and of sheep affected with the "staggers," (*Cœnurus cerebralis.*) This wide embryonic distribution explains the presence of tape-worm in almost every dog which has been subjected to examination. The *Cysticercus fasciolaris* of the mouse becomes the *Tænia crassicollis* of the cat. On the other hand, by administering living joints or segments of the tape-worm (which contain ova) to the proper animals, we can produce the same immature encysted parasite from which that sort of tape-worm is developed. Kuchenmeister produced *Tænia serrata* in a dog from the *Cœnurus* of sheep, and then fed some joints of the worm to young lambs, producing in them *Cœnurus* and consequent "staggers." Leuckart produced the *Cysticercus fasciolaris* in mice, by giving them segments of *Tænia crassicollis* from a cat.

The *Trichina spiralis* has of late years attracted much attention, both in this country and in Europe, from having been recognized as the cause of a disease which had, although undoubtedly existing from remote times, been heretofore erroneously confounded with others having similar symptoms. Like other parasites it is introduced into the human system by eating flesh containing its immature larvæ. It is found occasionally in most warm-blooded animals—sheep, cattle, hares, rabbits, and hogs. It is almost universally from this latter animal that man is infected; and the hog itself probably derives the parasite from the rats and mice which so commonly infest sties, and are devoured by their occupants, as well as from garbage of animal origin.

According to Dr. Cobbold, Mr. H. Peacock, in 1828, observed certain

minute gritty particles in the substance of muscles in dissecting-room subjects, and made a preparation of muscle displaying them. Mr. Hilton next observed these specks, and first described the bodies as "probably depending upon the formation of very small *Cysticerci*." Mr. Wormald also observed the characteristic specks in human muscle, and furnished Professor Owen with the specimens on which he drew up his article. Paget first actually determined the existence of the entozoön while a medical student, and read a paper before a society one week before Professor Owen presented his article; it is to Owen that we owe the first scientific description and the name of the *Trichina spiralis*.

The immature parasites, as seen in muscle under the microscope, are worms about $\frac{1}{25}$ of an inch in length, spirally coiled up within globular, oval, or lemon-shaped transparent cysts, which, according to the length of time they have been formed, are more or less covered with calcareous matter. According to Leuckart, however, the cysts are to be considered rather as abnormalities, developed some little time after the larvæ have reached their destination, as hundreds of specimens have been seen to coexist entirely free from cysts. (See Figures 1, 2, and 3.)

The number found in any one subject varies, but Leuckart estimated that one ounce of cat flesh which he observed must have harbored more than 300,000 parasites. Even if we assume that the forty-five pounds of muscle which an ordinarily healthy man possesses were infested with only 50,000 *Trichinæ* to the ounce, they would still contain more than thirty millions.

The sexually mature male *Trichina*, according to Cobbold, is about $\frac{1}{18}$ of an inch long, while the adult female is $\frac{1}{8}$; the body is rounded and slender, and the head very narrow and sharply pointed. The mode of reproduction is viviparous. The muscular parasite, when introduced into the alimentary canal of man or animal, is set free in the process of digestion, and in two days' time reaches the adult condition. Leuckart states that in six days more the female brings forth a numerous brood of minute hair-like larvæ; these soon begin their wanderings by piercing the intestinal walls, after which they proceed through the system till they reach the muscles, into which they penetrate; here they develop so that in two weeks more, that is, in about three weeks from the time the infested food was taken, they present the appearance of the ordinary muscular *Trichina spiralis*, as shown in Fig. 1.

The sexually mature worms probably produce more than one brood of young; they have been found alive in the intestines eight weeks after the ingestion of the flesh in which they were contained. The larvæ remain in the muscles they have reached, and shortly become encysted as heretofore mentioned. Smoking the meat does not kill the parasites it contains; brine, if very strong and long applied, probably does; thorough cooking certainly does. Time also has its effect on them, though they are endowed with wonderful vitality. In some healthy subjects who died from accident, the larvæ and their inclosing cysts have been found to have undergone calcareous degeneration; but it is probably months, and even years, before death of the parasite occurs; in illustration of which, Virchow states that in one case he found them alive eight, and in another thirteen and a half years after infection.

Professor Zenker first discovered the consequences to which the presence of this parasite in great numbers gives rise. In January, 1860, a servant girl died in the Dresden hospital, after an illness of about a month. The case, in the first stage, presented the following symptoms: "Lassitude, depression, sleeplessness, loss of appetite, and fever," so that it was thought to be a case of typhoid fever; but there supervened

excessive pain in the muscles, especially of the limbs, contractions of the knee and elbow, swelling of the legs, and finally pneumonia, which ended the patient's sufferings. On post mortem examination the muscles were found crowded with enormous numbers of the *Trichina spiralis*, and to be in a state of very marked (fatty) degeneration. The girl had been a servant in a family where two pigs and an ox had been killed for the Christmas festivities. Zenker, knowing that both animals were liable to the presence of this parasite, examined their flesh with the microscope, and demonstrated the presence of numerous *Trichinæ* in the pork. He also learned that all the patient's fellow-servants had become more or less ill about the same time, and that the butcher who slaughtered the animals had ever since that event been seriously ill, suffering rheumatic pains in his limbs, and seeming to be paralyzed over his whole body. It is a habit among German butchers to taste the raw flesh of the animals they slaughter, and from this circumstance Zenker was led to believe that he also was a victim to this parasite. Numerous experiments with trichinous flesh (this girl's among others) made on animals have proved that Zenker's discovery is correct. Virchow, Leuckart, Davaine, Turner, Thudicum, Cobbold, Dalton, and others, have verified the fact. Nor has other and more serious corroborative evidence been wanting. Wunderlich has reported four cases among the butchers of an establishment, who were taken ill after eating some raw pork. At Planen, in Germany, thirty persons were attacked, of whom one died. At Calbe seven out of thirty-eight cases were fatal. In October, 1863, the town of Heltstadt was the scene of an outbreak of trichiniasis, following a hotel dinner where one hundred and three of the citizens had partaken of smoked sausage. In these cases the disease was distinctly traced to a pig which had been purchased for the purpose of making the sausage to be eaten at this festival, and which had been considered by the owner not to be in good condition. On the day after the dinner several of the partakers were attacked with diarrhœa, prostration, and fever, and the cases increased so rapidly that in one month twenty of the party were dead, and eighty more were suffering from the fearful malady. Examination of a portion of the sausage revealed the parasites, and portions of muscle from some of the living sufferers and from the dead victims demonstrated the cause of the outbreak. When the epidemic ceased twenty-eight cases had died, every appliance of the medical art had been tried, and the disease had been observed with such care that all its features can hereafter be recognized without difficulty.

The violence of an attack seems to depend considerably on the number of parasites introduced into the patient's intestinal canal; something also depends, probably, on the length of time the parent parasites live, or the number of broods they produce. The previous constitution and strength of the sufferer also modify this as they do other disorders.

Cases which have occurred in the United States have closely resembled those recorded in Germany, of which that of the servant girl above mentioned may be taken as a type.

The disease makes its appearance a few days after the introduction of infested food, with abdominal pain and tenderness, nausea or vomiting, a feeling of lassitude, loss of appetite, and high fever. This condition of things is due to the development of the larvæ in the intestinal canal, and to the irritation produced by their penetration of its walls and contiguous membranes. Later in the disease, and as the traveling parasites reach their destination in the muscles, occur vague but severe pains, with marked stiffness. The muscles swell, become tense and

hard, and are exceedingly painful on movement. As the case proceeds, from the third to the fifth week, there is frequently great difficulty in breathing, probably dependent on the invasion of the respiratory muscles by the parasite. Paralysis from the degeneration of the affected muscular tissues is found in some severe cases, and sometimes continues in a more or less degree for some time after the other symptoms have disappeared. Death is generally preceded by extensive inflammation of the lungs, and sometimes by delirium. Convalescence, in cases terminating favorably, is slow. The duration of an attack may be stated to be from four to eight weeks; that of recovery as much longer.

In this country, so far, the disease has been almost exclusively developed in our citizens of German birth. American cookery is much more thorough, at least in the case of meats, than is that of Europe, especially in the West, where most of the epidemics of trichiniasis have occurred among our adopted citizens, and it is perhaps fortunate that an amount of cooking which makes beef almost totally indigestible, is necessary to render pork fit for human consumption, even when unaffected by parasitic disease.

The treatment of trichiniasis in the human subject has so far been unsatisfactory in its results. In order to clear away any mature parasites which may be in the intestinal canal, the use of cathartics, such as castor oil, is recommended. Mozler and Niemeyer unite in advising that benzine, in doses of one or two fluid drachms, in gelatine capsules, should be given for its supposed efficiency against the intestinal *Trichinæ*. The pain may be modified by long-continued hot baths. Quinine, in small doses, for the fever, stimulants for the prostration, and iron, in some form, for the anæmia during convalescence, are obvious resources.

But far more good is to be accomplished by prevention than by any treatment. Pork, in every form, should be thoroughly cooked before being eaten. If all meat presented for sale in markets could be examined microscopically before being sold, it would be the most efficacious means of preventing future epidemics. In many parts of Germany, but more particularly in Prussia, legal means of prevention have been attempted, with considerable success. Either the butcher is compelled to own and use a microscope for the examination of the meat of the animals slaughtered by him, or to submit such meat to the inspection of a government official provided with proper instruments of investigation. Microscopes for the especial purpose of detecting *Trichinæ* are now manufactured and for sale throughout Germany, accompanied by such directions and descriptions as will enable any one of ordinary intelligence to detect the parasite in any of its forms. Of course severe penalties enforce the examination of meat exposed for sale, and several butchers have been punished for neglect or violation of the laws in this respect.

As in this country we can hardly expect legislation on this subject, microscopic examination, if made at all, must be at the charge of the purchaser, and, wanting this security, the advice to avoid raw or partly cooked ham, sausage, &c., is reiterated. In addition, the offal and body of every hog the infection of which is undoubted, should be thoroughly destroyed by fire. In no other way can we be certain of having put an end to the wonderfully tenacious vitality of these and other parasites.

To prevent the *Trichinæ* from getting into our hogs, it is necessary to remember that the most likely sources of the parasite are the animal offal and garbage which they eat when allowed to run at large, and the rats they are apt to devour when they can get at them; in illustration of which fact it may be mentioned that the pigs in Ireland, which are allowed much more liberty of wandering, and are less regularly fed than

their congeners in England and Prussia, are more apt than these others to present the *Trichinæ* upon microscopic investigation. It is therefore advisable to keep pigs intended for human consumption in clean sties, containing only one or two each, and impervious to rats. The animals should be plentifully fed with sound grain, buttermilk, &c., well watered, and allowed some salt occasionally; in other words, placed in good hygienic conditions, and excluded from diseased food. It may perhaps seem unnecessary to dwell upon the value and necessity of measures which commend themselves at once as affording not only the best safeguard against the special disease under notice, but as going far toward the prevention of other diseases to which the hog is subject. Yet in view of the neglect and even positive abuse with which pigs are treated throughout the land, it is well that breeders should understand the fearful consequences liable to result from carelessness, which, in matters of such vital importance, is closely allied to criminality.

LAWS RELATING TO FENCES AND FARM STOCK.

In the older States the laws regulating fences are substantially alike. As to height, a legal fence is generally four and a half feet, if constructed of rails or timber. Ditches, brooks, ponds, creeks, rivers, &c., sufficient to turn stock, are deemed equivalents for a fence. In case a stream or other body of water is considered inadequate to the turning of stock, the facts are investigated by officers known as fence-viewers, who will designate the side of the water upon which a fence shall be erected, if the fence be deemed necessary, the cost to be equally borne by the parties whose lands are divided. Occupants of adjoining lands which are being improved are required to maintain partition fences in equal shares. Neglect to build or to keep in repair such fences subjects the negligent party to damages, as well as double, and in some States treble, the cost of building or repairing, to the aggrieved party. A person ceasing to improve land cannot remove his fence unless others interested refuse to purchase within reasonable time. A provision in the laws of several of these States, which is well calculated to serve the interests of neighbors, saving the expense of fence building, is one permitting persons owning adjoining lots or lands to fence them in one common field, and for the greater advantage of all, allowing them to form an association, and to adopt binding rules and regulations for the management of their common concerns, and such equitable modes of improvement as are required by their common interest; but in all other respects each proprietor may, at his own expense, inclose, manage, and improve his own land as he thinks best, maintaining his proportion of the general inclosure.

The laws regulating fences in the New England States differ only in a few particulars. The required height of a fence in Maine, Massachusetts, and New Hampshire, is four feet; in Vermont, four and a half feet; in Rhode Island a hedge with a ditch is required to be three feet high upon the bank of the ditch, well staked, at the distance of two and a half feet, bound together at the top, and sufficiently filled to prevent small stock from creeping through, and the bank of the ditch not to be less than one foot above the surface of the ground. A hedge without ditch to be four feet high, staked, bound, and filled; post-and-rail fence on the bank of a ditch to be four rails high, each well set in

post, and not less than four and a half feet high. A stone-wall fence is equired to be four feet high, with a flat stone over the top, or surmounted by a good rail or pole; a stone wall without such flat stone, rail, or post on top to be four and a half feet high. In each of the New England States there are plain provisions in regard to keeping up division fences on equal shares, and penalties for refusal to build them, and when built for neglect to keep them in repair. Fence-viewers in the respective towns settle all disputes as to division fences. Owners of adjoining fields are allowed to make their own rules and regulations concerning their management as commons. No one not choosing to inclose uncultivated land can be compelled to bear any of the expense ot a division fence, but afterward electing to cultivate, he must pay for one-half the fence erected on his line.

Similar provisions for the maintenance of division fences exist in New York; whenever a division fence has been injured by flood or other casualty, each party interested is required to replace or repair his proportion within ten days after notification. When electors in any town have made rules or regulations prescribing what shall be deemed a sufficient fence, persons neglecting to comply are precluded from recovering compensation for damages done by stock lawfully going at large on the highways, that may enter on their lands. The sufficiency of a fence is presumed until the contrary is established; assessors and commissioners of highways perform the duties of fence-viewers.

In Pennsylvania towns and counties secure special legislation as to the running of stock or other cattle at large. Fences in New Jersey are required to be four feet two inches in height, if of posts and rails, timber, boards, brick or stone; other fences must be four and a half feet, and close and strong enough to prevent horses and neat cattle from going through or under. Partition fences must be proof against sheep. Ditches and drains made in or through salt marshes and meadows for fencing and draining the same, being five feet wide and three feet deep, and all ditches or drains made in or through other meadows being nine feet wide at the surface and four and a half feet wide at the bottom, three feet deep, and lying on mud or miry bottom, are considered lawful fences. Division fences must be equally maintained. If one party ceases improving he cannot take away his fence without first having given twelve months' notice. Hedge-growing is encouraged by law.

In Newcastle and Kent Counties, Delaware, a good structure of wood or stone, or well-set thorn four and a half feet high, or four feet with a ditch within two feet, is a lawful fence; in Sussex County four feet is the height required. Fence-viewers are appointed by the court of general sessions in each "hundred." Partition fences are provided for as in other States.

There is no general law in Maryland regulating fences, the law being local and applicable to particular counties. In Virginia a lawful fence is five feet in height, including the mound to the bottom of the ditch, if the fence is built on a mound. Certain water courses are specified as equivalent to fences. Four feet is the height of a legal fence in West Virginia, and five feet in North Carolina. In the latter State persons neglecting to keep their fences in order during the season of crops are deemed guilty of misdemeanor, and are also liable to damages. Certain rivers are declared sufficient fences.

In South Carolina fences are required to be six feet high around "provisions." All fences strongly and closely made of rails, boards, or posts and rails, or of an embankment of earth capped with rails or timber of any sort, or live hedges five feet in height, measured from the

level or surface of the earth, are deemed lawful; and every planter is bound to keep such lawful fence around his cultivated grounds, except where a navigable stream or deep water-course may be a boundary. No stakes or canes that might injure horses or cattle are allowed in an inclosure.

The laws of Georgia provide that all fences, or inclosures commonly called worm fences, shall be five feet high, and from the ground to the height of three feet the rails must not be more than four inches apart. All paling fences are required to be five feet from the ground, and the poles not more than two inches apart. Any inclosure made by means of a ditch or trench must be three feet wide and two feet deep, and if made of both fence and ditch, the latter must be four feet wide and the fence five feet high from the bottom of the ditch. All water-courses that are or have been navigable are deemed legal fences as far up the stream as navigation has ever extended, whenever, by reason of freshets or otherwise, fences cannot be kept, and are subject to the rules applicable to other fences. The fences in Florida are required to be five feet in height, but where there is a ditch four feet wide the five feet may be measured from the bottom of the ditch. If the fence is not strictly according to law, no action for trespass or damages by stock will lie. In Alabama all inclosures and fences must be at least five feet high, and, if made of rails, be well staked and ridered, or otherwise sufficiently locked; and from the ground to the height of three feet the rails must be not more than four inches apart; if made of palings, the poles must be not more than three inches apart; or if made with a ditch, four feet wide at the top; the fence, of whatever material composed, must be five feet high from the bottom of the ditch and three feet from the top of the bank, and close enough to prevent stock of any kind from getting through. No suit for damages can be maintained if the fence is not a legal one. For placing in an inclosure any stakes, pits, poison, or anything which may kill or injure stock, a penalty of $50 is provided. Partition fences must be equally maintained. Fences in Mississippi are required to be five feet high, substantially and closely built with plank, pickets, hedges, or other substantial materials, or by raising the ground into a ridge two and a half feet high and erecting thereon a fence of common rails or other material two and a half feet in height. Owners of adjoining lands, or lessees thereof for more than two years, are required to contribute equally to the erection of fences, if the lands are in cultivation or used for pasturing. No owner is bound to contribute to the erection of a dividing fence when preparing to erect a fence of his own, and to leave a lane on his own land between himself and the adjoining owner; but the failure to erect such fence for sixty days is deemed an abandonment of intention to do so, and determination to adopt the fence already built.

In Texas every gardener, farmer, or planter is required to maintain a fence around his cultivated lands at least five feet high and sufficiently close to prevent hogs from passing through it, not leaving a space of more than six inches in any one place within three feet of the ground. Fences in Arkansas must be five feet high. In all disputed cases the sufficiency of a fence is to be determined by three disinterested householders, appointed by a justice of the peace. Division fences are provided for as in the majority of the other States. In Tennessee every planter is required to make a fence around his cultivated land at least five feet high. When any trespass occurs a justice of the peace will appoint two freeholders to view the fence as to its sufficiency, and to ascertain damages. If a person, whose fence is insufficient, should

injure any animal which may come upon his lands, he is responsible in damages. In case of dispute between parties as to a division fence, a justice of the peace will appoint three disinterested freeholders to determine the portion to be maintained by each. No owner, whose fence is exclusively on his own land, can be compelled to allow his neighbor to join it. In Kentucky all sound and strong fences of rails, plank, or iron, five feet high, and so close that cattle or other stock cannot creep through, or made of stone or brick four and a half feet high, are deemed legal fences. Division fences cannot be removed without consent of the party on adjoining land, except between November 1 and March 1 in any year, six months' notice having been given. In Missouri all fields must be inclosed by hedge or fence. Hedges must be five feet high; fences of posts and rails, posts and palings, posts and plank, or palisades, four and a half feet; turf, four feet, with trenches on either side three feet wide at top and three feet deep; worm fence at least five feet high to top of rider, or, if not ridered, five feet to top rail, and corner locked with strong rails, poles, or stakes. Double damage may be recovered from any person maiming or killing animals within his inclosure if adjudged insufficient. In Illinois fences must be five feet high. The laws regulating division fences are similar to those of the New England States. In cases of dispute three disinterested householders decide as to the sufficiency of any fence. Proprietors of commons may make their own regulations. Line fences are protected on public highways. In Indiana any structure or hedge, or ditch, in the nature of a fence, used for purposes of inclosure, which shall, on the testimony of skillful men, appear to be sufficient, is a lawful fence.

The laws of Ohio provide that whenever a fence is erected by any person on the line of his land, and the person owning the land adjoining shall make an inclosure on the opposite side, the latter shall pay one-half the value of the fence as far as it answers the purpose of a division fence, to be adjudged by the township trustees. A legal fence in Wisconsin is four and a half feet high if of rails, timber, boards, or stone walls or their combinations, or other things which shall be deemed equivalent thereto in the judgment of the fence-viewers. While adjoining parties cultivate lands they must keep up fences in equal shares; double value of building or repairing may be recovered from delinquents. The law regulating division fences is similar in most particulars to those of the New England States and Illinois. Overseers of highways perform the duties of fence-viewers.

Fences in Michigan must be four and a half feet high, and in good repair; consisting of rails, timber, boards, or stone walls, or any combination of these materials. Rivers, brooks, ponds, ditches, hedges, &c., deemed by the fence viewers equivalent to a fence, are held to be legal inclosures. No damages for trespass are recoverable if the fence is not of the required height. Partition fences must be equally maintained as long as parties improve their lands. When lands owned in severalty have been occupied in common, any occupants may have lands divided. Fences extending into the water must be made in equal shares, unless otherwise agreed by parties interested. If any person determines not to improve any portion of his lands adjoining a partition fence, he must give six months' notice to all the adjoining occupants, after which he will not be required to keep up any part of the fence. Overseers of highways act as fence-viewers.

In Minnesota four and a half feet is the legal height. Partition fences are to be kept in good repair in equal shares. In case of neglect, complaint may be made by the aggrieved party to the town supervisors,

who will proceed to examine the matter, and if they determine that the fence is insufficient, notice will be given to delinquent occupant of land; and if he fails to build or repair within a reasonable time, the complainant may build or repair, and may recover double the expense, with interest at the rate of one per cent. per month, in a civil action. No part of a division fence can be removed if the owner or occupant of adjoining land will, within two months, pay the appraised value. When any uninclosed grounds are afterward inclosed, the owner or occupant is required to pay for one-half of each partition fence; the value thereof to be determined by a majority of the town supervisors. If a party to a division fence discontinues the improvement of his land, and gives six months' notice thereof to the occupants of adjoining lands, he is not required to keep up any part of such fence during the time his lands are unimproved, and he may remove his portion if the adjoining owner or occupant will not pay therefor. County commissioners are the fence-viewers in counties not divided into towns.

A legal fence in Iowa is four and a half feet high, constructed of strong materials, put up in a good, substantial manner. In all counties where, by a vote of the legal voters, or by an act of the general assembly, it is determined that hogs and sheep shall not run at large, a fence made of three rails of good, substantial material, or three boards not less than six inches wide and three-fourths of an inch thick, such rails or boards to be fastened in or to good, substantial posts, not more than ten feet apart where rails are used; or any other fence which, in the opinion of the fence-viewers, shall be equivalent thereto, is deemed a lawful fence, provided that the lowest or bottom rail shall not be more than twenty nor less than sixteen inches from the ground, and that the fence shall be fifty-four inches in height. The respective owners of inclosed lands must keep up fences equally as long as they improve. In case of neglect to repair or rebuild, the adjoining owner may do so, and the work being adjudged sufficient by the fence-viewers, and the value determined, the complainant may recover the amount, with interest at the rate of one per cent. per month. If an owner desires to throw his field open, he shall give the adjoining parties six months' notice, or such shorter notice as may be directed by the fence-viewers.

In Kansas fences may be of posts and rails, posts and palings, or posts and planks, at least four and a half feet high; of turf, four feet, and staked and ridered, with a ditch on either side at least three feet wide at top and three feet deep; a worm fence must be at least four and a half feet high to top of rider, or if not ridered, four and a half feet high to top rail, the corners to be locked with strong rails, posts, or stakes. The bottom rail, board or plank in any fence must not be more than two feet from the ground in any township, and in those townships where hogs are not prohibited from running at large it must not be more than six inches from the ground. All such fences must be substantially built and sufficiently close to prevent stock from going through. Stone fences are required to be four feet high, eighteen inches wide at the bottom, and twelve at the top. All hedges must be of sufficient height and thickness to protect the field or inclosure. A wire fence must consist of posts of ordinary size for fencing purposes, set in the ground at least two feet deep and not more than twelve feet apart, with holes through posts, or staples on the side, not more than fifteen inches apart, and four separate lines of fence wire, not smaller than No. 9, to be provided with rollers and levers at suitable distances, to strain and hold the wires straight and firm. Owners of adjoining lands must maintain fences equally. In case of neglect of one party to

build or repair, another party may do so and recover the amount expended, with interest at the rate of one per cent. per month. A person not improving his land is not required to keep up any portion of a division fence. The trustee, clerk, and treasurer in each township act as fence-viewers, to adjust all disputes concerning fences. A legal fence in Nebraska is described as any structure, or hedge, or ditch in the nature of a fence, used for the purposes of enclosure, which is such as good husbandmen generally keep. Division fences must be equally maintained. A party may remove his portion of division fence by giving sixty days' notice. If removed without such notice the party so doing is liable for full damages. Where a fence is injured or destroyed by fire or flood it must be repaired within ten days after notice by interested persons. Justices of the peace are *ex officio* fence-viewers.

Legal fences in California are described with great particularity. Wire fences must consist of posts not less than twelve inches in circumference, set in the ground not less than eighteen inches, and not less than eight feet apart, with not less than three horizontal wires, each one-fourth of an inch in diameter, the first to be eighteen inches from the ground, the other two above at intervals of one foot, all well stretched and securely fastened from post to post, with one rail, slat, pole, or plank, of suitable size and strength, securely fastened to the post, not less than four and a half feet from the ground. Post and rail fence must be made with posts of the same size and at the same distances apart and the same depth in the ground as above required, with three rails, slats, or planks of suitable size and strength, the top one to be four and a half feet from the ground, the other two at equal distances between the first and the ground, all securely fastened to the post. Picket fences must be of the same height as above, made of pickets not less than six inches in circumference, placed not more than six inches apart, driven in the ground not less than ten inches, all well secured at the top by slats or caps. Ditch and pole fence: the ditch must not be less than four feet wide on the top and three feet deep, with embankment thrown on inside of ditch, with substantial posts set in the embankment not more than eight feet apart, and a plank, pole, rail, or slat securely fastened to posts at least five feet high from the bottom of the ditch. Pole fence must be four and a half feet high, with stakes not less than three inches in diameter, set in the ground not less than eighteen inches, and when the stakes are placed seven feet apart there must not be less than six horizontal poles well secured to the stakes; if the stakes are six feet apart, five poles; if three or four feet, four poles; if two feet apart three poles, and the stakes need not be less than two inches in diameter; if one foot apart, one pole, and the stakes need not be more than two inches in diameter. The above is a lawful fence so long as the stakes and poles are securely fastened and in a fair state of preservation. Hedge fence is considered lawful when by reliable evidence it shall be proved equal in strength and as well suited to the protection of inclosed lands as the other fences described. Brush fence must be four and a half feet high and at least twelve inches wide, with stakes not less than two inches in diameter, set in the ground not less than eighteen inches, and on each side, every eight feet, tied together at the top, with horizontal pole tied to the outside stake five feet from the ground. In the case of partition fences, if one party refuse or neglect to build or maintain his share the other may do so and recover the value. Three days' notice to repair is sufficient. The sufficiency of a fence is to be determined by three disinterested householders.

STOCK LAWS.

In a majority of the States there are general laws prohibiting cattle and other stock from running at large; in some instances, however, authority is delegated to counties or towns to make by-laws upon the subject, or there is special legislation for particular counties or districts. The law of estrays differs in the various States in no essential particulars. If a beast is found running at large, in violation of law, it may be taken up and impounded, where public pounds have been provided; or it may be held by the person so taking up on his own premises. If the owner is known, notice must be given to him at once; if unknown, the animal must be advertised for a specified time; and no owner claiming it, must be sold to the highest bidder. The person taking up the estray is entitled to a reasonable compensation for maintaining the beast. In some States, after a certain time, the estray becomes the property of the person taking it up, the prescribed legal notice having been given. When an animal is found doing damage on the land of another, the fences being constructed according to law, it may be held as security for damages. In all cases where the owner is known, he must be notified of the facts, and a reasonable time allowed him to reclaim and to inspect damages. In the majority of the States, also, owners of stock are required to adopt certain ear marks, marks, or brands, and to make a record of them.

A glance at some of the principal features of the laws relating to stock in the several States will show the importance attached to the subject, and may prove suggestive to communities where legislation is defective. In a former report of this Department a digest of the laws concerning the destruction of sheep by dogs was published, and that branch of the subject need not now be considered. In Maine and New Hampshire, towns may make by-laws concerning the running of animals at large. The laws of Maine provide that persons injured by beasts may sue for damages, and distrain the animal. New Hampshire allows the owner of stock impounded for doing damage four days to respond to notice of the fact; and if he fails to answer, the animals may be sold and the amount of the damages be deducted from the proceeds. In Vermont, twenty days are allowed for redemption. Ungelded animals are not allowed to run at large. Rams must be restrained from August 1 to December 1, and be marked with the initials of the owner's name; and if found at large, a forfeit of $5 is due for each one taken up to the person so taking up. The owner of such animals is responsible for all damages done by them. Sheep infected with foot rot or scab must be diligently restrained, and for all damages resulting from neglect of this provision the owner is responsible, and is also subject to a fine of $10. Any person finding such diseased animals at large, may take them as forfeit, and no action at law or in equity will lie for their recovery. Any person who shall drive, or in any manner bring, into the State any neat cattle, knowing them, or any of them, to have the pleuro-pneumonia, or of having been exposed to that disease, is liable to a forfeit of a sum not over $500, or to imprisonment in a county jail for not more than twelve months, nor less than one month. Towns may establish regulations, appoint officers or agents, and raise and appropriate money for the purpose of preventing and arresting the spread of pleuro-pneumonia.

The laws of Massachusetts provide that when a person is injured in his crops or other property by sheep, swine, horses, mules,, or neat cattle, he may recover damages in an action of tort against the owner of the beasts, or by distraining the beasts doing the damage; but if the beasts

were lawfully on the adjoining lands, and escaped therefrom in consequence of the neglect of the person who suffered the damage to maintain his part of the division fence, the owner of the beasts shall not be liable for such damages. The selectmen of towns and the mayor and aldermen of cities, in case of the existence of pleuro-pneumonia or any other contagious disease among cattle, shall cause the infected animals or those exposed to infection to be secured in some suitable place or places, and kept isolated, the expense of keeping to be paid, one-fifth by city or town, and four-fifths by the State. They may prohibit the departure of cattle from any inclosure, or exclude them therefrom; may make rules in writing to regulate or prohibit the passage of any neat cattle to or through their respective cities or towns, or from place to place, and arrest and detain them at the cost of the owners. They are authorized to brand infected animals, or those exposed to infection, with the letter P on the rump. For selling an animal so branded, there is liability to fine not exceeding $500, or imprisonment not exceeding one year. Notice of any suspicion of the existence of contagious disease must be given, with a penalty for neglect or refusal. A board of commissioners is appointed for the State, with authority to use any measure to control the introduction of diseased cattle into the State, or the spread of disease. The rules and regulations made by this board supersede those of the selectmen of towns, and mayor and aldermen of cities. The moving of cattle into other States without permission is prohibited. The law of 1867 provides that no cattle diseased, or suspected of being diseased, shall be killed, except by order of the governor. The owners of cattle ordered to be killed are indemnified.

In Rhode Island, animals trespassing on lands are held a year and a day; and, if a horse, must have a withe kept about his neck during that time. Each town is required to erect and maintain at its own charge one or more public pounds, and it is lawful for any freeholder or qualified elector or field driver, and it is made the duty of every surveyor of highways, to take up and impound any horse, neat cattle, sheep, or hog found at large in any highway or common. Provisions of the act extend also to goats and geese. In 1860, in view of the dangerous disease which had become prevalent in other States, the general assembly enacted that neat cattle might only be brought into the State from places west of the Connecticut River, upon thoroughfares leading into the western and the southern portions of the State, under regulations established by a board of commissioners, until they should prohibit importations from any of said places. For a violation of the provisions of the act, a penalty was provided, not exceeding $300 for each offense, and liability to indictment, and, on conviction, imprisonment not exceeding one year. In case of the introduction of a number of diseased cattle at the same time, the introduction of each animal is to be deemed a separate and distinct offense. Town councils are empowered to take all necessary measures to prevent the breaking out or spreading of any infectious diseases among the neat cattle in their respective towns, and to prescribe penalties in money, not exceeding $500. A board of commissioners is provided for, to be appointed by the governor, consisting of one person from each county, to see that the law is faithfully executed. It is made the especial duty of the board to endeavor to obtain full information in relation to the disease known as pleuro-pneumonia, and to publish and circulate the same, at their discretion; and in case the disease should break out, or there should be a reasonable suspicion of its existence in any town, they are required to examine the several cases and publish the result of their

examination, in order that the public may have correct information. If satisfied of its existence in any town, they must give public notice of the fact in printed handbills, posted up; and, thereafter, any incorporated company or person who may drive, carry, or transport any neat cattle out of the town into any other town in the State, is liable to the penalties above stated. Any person who sells or offers to sell any cattle known to be infected with pleuro-pneumonia, or with any disease dangerous to public health, is liable to indictment, and, on conviction, to punishment by fine not exceeding $1,000, or imprisonment not exceeding two years. The act of March 26, 1864, provides that any person knowingly bringing into the State any neat cattle or other animals suffering from any infectious disease, or who knowingly exposes such cattle or other animals to other cattle and animals not infected with such disease, shall, upon conviction, pay a fine of not less than $100, and not exceeding $500.

The laws of Connecticut allow owners of sheep to keep flocks in common, and to make their own rules and regulations concerning their care and safety. No horses, asses, mules, neat cattle, sheep, swine, or geese are allowed to go at large in any highway or common, or to roam at large for the purpose of being kept or pastured on the highway or commons, either with or without a keeper. Any person may seize and take into his custody and possession any animal which may be trespassing upon his premises, provided the animal enter from the highway, or through a fence belonging to the owner of the animal, or through a lawful fence belonging to any other person. He must give immediate notice to the owner, if known, and may demand for every horse, mule, ass, ox, cow, or calf, 25 cents; and for every sheep, goat, goose, or swine, 10 cents; together with just damages for injuries occasioned by such animals, if applied for within twenty-four hours after such notice shall have been given. If the owner is not known, the animal shall be sold by the town clerk, after due public notice.

The cattle laws of New York allow any person to seize and take into his custody any animal which may be in any public highway, and opposite to land owned or occupied by him, or which may be trespassing upon his premises. Notice must be given to a justice of the peace, or a commissioner of highways of the town in which the seizure has been made, who shall post up notices in six public places that the animal will be sold in not less than fifteen nor more than thirty days. The surplus money, after payment of all charges, is subject to the order of the owner for one year. The owner, before sale, may pay all charges and take the animal. If the animal has been trespassing by the willful act of another than the owner to effect that object, the owner is entitled to the animal upon making demand, after paying the compensation fixed by the justice or commissioner, but no other costs; and the person committing such willful act will be held liable to a penalty of $20.

In New Jersey town committees, upon notice of the existence of any disease supposed to be contagious, are required personally to examine the cause, and if the symptoms which characterize contagious diseases are exhibited, shall cause such animals to be removed and kept separate and apart from other cattle and stock, five hundred feet distant from any highway, and the same distance from any and all neighbors. If any die of the disease, or are killed, they must be buried immediately, five hundred feet distant, &c., as above. No cattle that have been sick, and have recovered from any supposed contagious or infectious disease, shall mix with other cattle, or be removed, unless permission has been given by the town committee. Any person knowingly storing a hide,

or any other portion of a diseased animal, is subject to a fine. The town committee are authorized to prohibit the importation or passage of cattle from other places into or through their respective towns. After notice of prohibition, owners are liable to a fine of $100 for every animal driven into a township. A fine of $100 is imposed for every animal sold and known to be diseased. The act of 1866 authorizes the Agricultural Society of the State to take measures for preventing the introduction or increase of rinderpest, and any other disease among cattle, at their discretion. In this State, animals affected with glanders are authorized to be killed. Cattle must not be marked by cropping both ears; nor must either ear be cropped more than one inch.

The running of cattle at large is controlled in Pennsylvania by towns and counties, through special legislation. The sale of cattle or sheep affected with pleuro-pneumonia, or any other contagious or infectious disease, is punished by fine not exceeding $500, or imprisonment not exceeding six months. Animals must not be sold alive from, or slaughtered on, premises where disease is known to exist, nor for a period of two months after disease shall have disappeared from the premises. Cattle and sheep are not allowed to run at large where any contagious disease prevails. Constables of townships are required to take up and confine any animals so found, until all costs are paid.

In Delaware, by act of general assembly, cattle are forbidden to run at large in certain districts. Stallions over eighteen months old are not permitted to be at large.

The laws of Maryland provide that any person aggrieved by trespass upon his premises of any cattle, hogs, or sheep in the possession or care of a non-resident, may impound them, and have the damages sustained by the trespass valued on oath by two disinterested citizens of his county, and the animals may be sold for the damages and costs.

The laws of Virginia provide that if any horses, cattle, hogs, sheep, or goats enter into any grounds inclosed by a lawful fence, the owner or manager shall be liable to the owner of the ground for all damages; and for every succeeding trespass by such animals, the owner shall be liable for double damages; and, after having given at least five days' notice to the owner of the animals of the fact of two previous trespasses, the aggrieved party shall be entitled to the animals if again found trespassing on the same lands. Horses diseased and unaltered, are not allowed to be at large. Every person shall so restrain his distempered cattle, or such as are under his care, that they may not go at large off the land to which they belong; and no person shall drive any distempered cattle into or through the State, or from one part of it to another, unless it be to remove them from one piece of ground to another of the same owner; and when any such cattle die, the owner thereof, or person having them in charge, shall cause them to be buried (with their hides on) four feet deep. Any justice, upon proof before him that any cattle are going at large, or are driven in or through his county or corporation, in violation of law, may direct the owner to impound them; and if he fail to do so, or suffer them to escape before obtaining a certificate that they may be removed with safety, they shall, by order of the justice, be killed and buried four feet deep, with their hides on, but so cut that no one may be tempted to dig them up. For the protection of sheep special laws have been passed taxing dogs in certain counties, and for their restraint in those counties.

In North Carolina, if cattle are driven from one part of the State to another, they must be certified to be healthy, sound, and free from any infectious distemper; the granting of such certificate by any justice,

without affidavit, is a misdemeanor in office. Stallions and mules over two years old are not allowed to go at large, under a penalty of $20. Damages for injury done by trespassing animals are recoverable as in other States.

In South Carolina horses, cattle, hogs, sheep, or goats breaking into any field having a crop of any kind growing or ungathered, with a lawful fence, may be seized and kept confined until notice is given to the owner, within twenty-four hours of the seizure, who shall be bound to pay the owner of such field 50 cents a head for each horse or mule, and 25 cents for every head of cattle, hogs, &c., before he is entitled to have the animal delivered up to him. For the second breaking, within one month after the first, the owner is liable to the person injured for all damages sustained, in addition to the fine. Full satisfaction lies for injuring any animal found in any field where the fence is not a lawful one.

In the State of Georgia, if any trespass or damage is committed by stock on any lands not protected by lawful fences, the owner of the animal is not liable to answer for trespass; and if the owner of the premises should kill or injure the animal in any manner he is liable in three times the damages. When fences are made pursuant to law, and any animal breaks in, the owner of the inclosure shall not kill or injure him for the first breaking, and not until after notice is given to the agent or owner, if possible, but the owner shall be liable for double the damage done by his stock.

In Florida there can be no trespass or damage if the fence is not a lawful one; nor in such case can stakes, canes, or other devices to maim or kill cattle, sheep, swine, &c., be used, under a penalty of $10 for each offense and full damages. Marks upon stock are required.

Any person is allowed in Alabama to take up any horse, mare, jack, neat cattle, hog, or sheep found running at large, if the owner is unknown. If any stallion or jackass over two years of age is found at large it must be taken before a justice who shall cause it to be advertised. The taker up is entitled to $5 from the owner, and reasonable compensation for keeping. If such stallion or jackass is not claimed within three months it may be gelded.

The laws of Mississippi provide that every owner of cattle, horses, mules, hogs, sheep, or goats shall be liable for all injuries and trespasses committed by breaking into grounds inclosed by legal fence. If any person whose fence is not a lawful one, shall hurt, wound, lame, or kill, by shooting, or hunting with dogs, or otherwise, any cattle, &c., that may have broken into his inclosure, he shall pay the owner double damages. A ranger is elected in each county to attend specially to estrays, of which he is required to keep a record. When any person finds horses, mules, jacks, cattle, sheep, or hogs straying upon his land he may take them up and forthwith send them to the owner, if known; if unknown, he must give notice to the ranger, or some justice of the peace. The owner of all estrays appraised at $10 and not exceeding $20 is allowed six months, and if less than $10, three months, from the date of certificate of appraisement to claim and prove his property. It is not lawful for any drover or other person to drive any horses, mules, cattle, hogs, or sheep of another from the range to which they belong; but it is made his duty if any such stock join his, to halt immediately at the nearest pen, or some other convenient place, and separate such stock as does not belong to him, or to the person by whom he may be employed. For neglect a forfeit of $20 for every offense is provided, and liability to all damages. Any person may confine and geld any

stallion above the age of two years, found running at large, at the risk of the owner, but this will not apply to stallions usually kept up, but to those which accidentally escape. Any animal addicted to fence breaking may be taken up by owner of land, who may recover 75 cents a day for keeping, provided owner has been notified, if known; but condition of fence may be shown in mitigation of damages. Double damages may be recovered for injury to animals where fence is not a lawful one. Defacing or altering marks of animals subjects to a penalty of imprisonment in the penitentiary for not more than three years, or fine of not more than $500, and imprisonment in county jail for not more than one year, or both.

No neat cattle belonging to non-residents are allowed to be taken into Texas for grazing or herding purposes, under pain of forfeiture to the county into which they shall have been so taken. Severe penalties for altering the brands of animals are provided in this State.

In Arkansas, if any horse, cattle, or other stock break into any inclosure, the fence being of the required height and sufficiency, the owner of the animal shall, for the first offense, make reparation for true damages; for the second offense, double damages; and for the third the party injured may kill the trespassing beasts, without being answerable. If any stallion or jack over two years old is found running at large, the owner may be fined $2 for the first offense, and $10 for each subsequent offense, and is liable for all damages that may be sustained. Any person may take up such animal, and, if not claimed within two days, may castrate, and recover $3 for doing so; but the life of the animal must not be endangered. If any such animal cannot be taken up, he may be killed, if notice be first put up at the court-house, and at three other of the most public places in the county for ten days, accurately describing the animal.

In Tennessee stallions and jackasses over fifteen months old are not allowed to run at large under penalty to the owner of not less than $5 or more than $25. The animal may be taken before the nearest justice of the peace who shall give public notice. If not claimed within three months the animal may be gelded at the risk and expense of the owner. The party taking him up is entitled to $5 and reasonable expenses for keeping.

There is no law in force in West Virginia to prevent cattle from running at large; but if they break into an inclosure and destroy any grain or crops, the owner is liable, provided the fence is a lawful one. A law exists to prevent diseased sheep from traveling on the highway.

In Kentucky breechy and mischievous bulls may be taken up and altered; a jack or stallion may be gelded if found at large, allowing the owner, if known, at the rate of twenty-five miles a day to reach the place where the animal is held, and recover the animal; when the owner is not known, the animal is dealt with as an estray, and may be ordered by a justice to be gelded. If the owner of any distempered cattle permits them to run at large, or drives them through any part of the State, he is liable to a fine of $10 for each head; and if any die the owner must cause them to be buried, subject to a penalty of $5 for neglect in each case.

The State of Missouri has created a board of cattle inspectors to prevent the spread of the Texas or Spanish fever. The county court of each county is authorized to appoint three competent and discreet persons to act as a board for the inspection of cattle supposed to be distempered or affected with the disease known as the Texas or Spanish fever. They may stop any drove of cattle. If they adjudge cattle to

be diseased or distempered, and in a condition to communicate any contagious or infectious disease, they are required to order the cattle to be removed from the county without delay, upon the same route upon which they came in, if practicable. If the owners comply with the order they will not be further liable; but if they, or the persons having the cattle in charge, willfully delay or neglect to do so, the president of the board will direct the sheriff to drive the cattle out by the route they came in, or to kill them, if the board think it necessary in order to prevent the spread of the disease. The parties owning or in charge of the cattle ordered to be removed or killed are liable for all the costs that may accrue in case of examination, removal, or killing. The act to prevent the introduction of diseased cattle into the State provides that no Texas, Mexican, or Indian cattle shall be driven or otherwise conveyed into any county in the State between the first day of March and the first day of December in each year, but this does not apply to any cattle which have been kept the entire previous winter in the State. Cattle may be carried through the State by railroad or steamboat, provided they are not unloaded, but the railroad company or owners of the steamboat are responsible for all damages which may result from the Spanish or Texas fever, should the same occur along the line of transportation; and the existence of such disease along the route shall be *prima facie* evidence that the disease has been communicated by such transportation. For every head of cattle brought into the State contrary to law a fine of $20 may be recovered, or the party may be imprisoned in the county jail not less than three nor more than twelve months, or may be subjected to both fine and imprisonment. It is lawful for any three or more householders to stop any cattle which they may have good reason to believe are passing through any county in violation of the act.

In Illinois the owner of animals breaking through a legal fence is liable to full damages for the first trespass, and to double damages for any subsequent trespass. Where the fence is insufficient, and the landowner injures or destroys animals, he is answerable in damages. Stallions over one year old are not permitted to run at large; but if so found may be gelded, if the owner does not reclaim them, one day for every fifteen miles' distance of the animal from home being allowed, after notice. Diseased horses, mules, and asses must be kept within the owner's inclosure, under penalty of $20 damages. Estray hogs must be sold between November 1 and March 1. To convey any Texas or Cherokee cattle into the State between the first day of October and the first day of March renders the party so doing liable to a fine not exceeding $2,000 nor less than $500, and imprisonment at the discretion of the court. Any and all fines are paid into the county treasury, subject to the order of the board of supervisors or county court, for the purpose of being divided *pro rata* among persons who may have suffered damage or loss on account of any such Texas or Cherokee cattle. All persons or corporations are liable to injured parties for any damage arising from the introduction, by any of them, of any diseased cattle. It is made the duty of any circuit or county judge, or justice of the peace, upon oath of any householder, setting forth that Texas or Cherokee cattle are spreading disease among the native cattle, to forthwith issue a warrant to any sheriff or constable of the county, commanding him to arrest and impound such cattle, and keep them by themselves until the first day of October following. "Texas and Cherokee cattle" are defined to mean a class or kind of cattle, without reference to the place from which they may have come.

In Indiana laws regulating the running at large of cattle and other

stock are local in their application, county boards designating what animals may or may not run at large. However, when any animal is found at large contrary to local law, and has been taken up, the owner may reclaim it within ten days, after which time the animal may be sold.

It is unlawful in the State of Ohio for any one to sell, barter, or dispose of, or permit to run at large, any horse, cattle, sheep, or other domestic animal, knowing them to be infected with contagious or infectious disease, or to have been recently exposed thereto, unless he first duly informs the party to whom he may sell as to the facts. The fine for so doing is not less than $20 nor more than $200, with costs, or confinement in the county jail not more than thirty days. For allowing infected animals to come in contact with animals belonging to another, a fine is provided of not less than $50 nor more than $500, with costs of prosecution, or confinement in county jail not less than ten nor more than fifty days. If any horse, mule, ass, or any neat cattle, hogs, sheep, or goats, running at large, break into or enter any inclosure other than inclosures of railroads, the owner is liable for all damages, and the animal so breaking into or entering an inclosure is not exempted from execution issued on any judgment or decree rendered by any court. For allowing any such animals to run at large in any public highway or upon any uninclosed land, or for herding any of them for the purpose of grazing on premises other than those owned or occupied by the owner or keeper of the animals, the party offending is liable, for every violation, to a fine of not less than $1 nor more than $5. But a general permission may be granted by the commissioners of any county for certain animals to run at large, and in counties where there is no such general permission, township trustees may grant special permits, such general and special permits terminating on the first Monday of March of each year; and special permits are revokable at the discretion of the trustees, upon three days' notice in writing to the owner of animals. Special permits must be directed to individuals, and for particular animals described therein. The owner of trespassing animals is liable for all damages upon premises of another without reference to the fence which may inclose the premises. Any person may take up and confine an animal found at large contrary to law, and the owner may reclaim the same within ten days. The fees are as follows: For taking up and advertising each horse or mule, $1; neat cattle, 75 cents each; swine, 50 cents each; sheep or geese, 25 cents each; and reasonable pay for keeping the same. It is unlawful for the owner or keepers of any animals knowingly to permit them to enter the inclosure of any railroad, or, having entered, to remain therein; or to lead or drive any such animals within the inclosure, or along or upon the track of any railroad, at any other place than the regular street or road crossing, farm crossing, or way.

In Michigan it is not lawful for any cattle, horses, sheep, or swine to run at large on the highway, except in those counties or parts of counties where it shall be otherwise determined by the board of supervisors in such county. Where the law is in force, any person may seize and hold in his possession any animal found running at large, and give notice to a justice of the peace or a commissioner of highways, who is required to post up notices describing the animal. The animal must be sold at public outcry in not less than thirty nor more than sixty days after date of notice; but the owner may redeem the animal by paying costs and compensation for keeping—redemption to be made within one year. An animal found trespassing by the willful act of another, may be taken by the owner on demand, after paying reasonable com-

pensation, but the person committing the act is liable to a fine of $20. Any person taking up a beast going at large contrary to law, or contrary to any by-law of a township, is entitled to 50 cents per head for all horses, mules, asses, and neat cattle, and 10 cents per head for all sheep, goats, and swine. When any person is injured in his land by animals, he may recover damages in an action for trespass against the owner of the beasts, or by distraining the beasts doing damage, unless the animals shall have been lawfully on adjoining lands, and shall have escaped therefrom in consequence of the neglect of the person who has suffered the damage, to maintain his part of the division fence.

The laws of Wisconsin permit towns to make regulations concerning the running of animals at large. The owner or occupant of lands may distrain all beasts doing damage within his inclosure, and when any distress shall be made the person distraining is required to keep such beasts in some place other than the public pound until his damages are appraised; and within twenty-four hours he shall apply to a justice of the peace, who shall appoint three disinterested free-holders to appraise the damages sustained. If within twenty-four hours after appraisement the damages are not paid, the animals may be placed in the public pound, to be there maintained until the amount of damages and costs is recovered by due process of law. If the owner of any sheep infected with contagious disease permits any of them to go at large out of his own inclosure at any season of the year, he shall forfeit the sum of $5 for each and every such sheep, to the person who may enter complaint, for each time they are so found running at large. If the owner neglects to restrain such sheep, any person is authorized to take them up and put them in some safe place other than the public pound. Rams are not permitted to go at large between July 15 and December 1, and the owner forfeits $10 to the person taking up the animal for each time so found abroad.

The electors of each town in the State of Minnesota have power at their annual meetings to determine the number of pound masters, and the location of pounds, and regulations for impounding animals, and to fix the time and manner in which cattle, mules, asses, and sheep may be permitted to go at large, provided that no cattle, horses, mules, nor asses be allowed to go at large between the 15th of October and the 1st of April. The owner or occupant of lands may distrain all beasts doing damage upon his lands during the night-time, from 8 o'clock in the evening until sunrise; and when any such distress is made the distrainer shall keep such beasts in some secure place other than the public pound, until his damages are appraised, unless the same is made on Sunday, in which case, before the next Tuesday morning thereafter he shall apply to a justice of the peace of the town, who shall appoint three disinterested persons to appraise damages. No damage can be recovered by the owner of any lands for damage committed by any beasts during the daytime, until it is first proved that the lands were inclosed by a lawful fence. Distress may be made at any time before the beasts doing damage escape from the lands, and without regard to the sufficiency of fences. The owner of any horse or other animal, having the disease known as the glanders, who knowingly permits such animal to run at large, or be driven upon any of the highways of the State, or any hotel keeper, or keeper of any public barn, who permits any animal having such disease to be stabled, such person shall be deemed guilty of a misdemeanor, and upon conviction before any justice of the peace, shall be punished by a fine of not more than $100 nor less than $25.

In Iowa no stallion, jack, bull, boar, or buck is permitted to run at

large. Persons aggrieved are allowed to distrain any such animals, and compel the owner to pay damages. If the animal is not redeemed within seven days, seven days' notice of its sale at public auction must be given, the proceeds to apply on damages after deducting costs. If any domestic animal, lawfully on adjoining land, escapes therefrom in consequence of the neglect of the person suffering the damage to maintain his part of the division fence, the owner of the animal is not liable for any damages. If beasts are not lawfully upon the adjoining land, and came upon it, or if they escaped therefrom into the injured inclosure, in consequence of the neglect of the adjoining owner to maintain a partition fence or any part of one, which it was his duty to maintain, then the owner of the adjoining land shall be liable as well as the owner of beasts. Fence viewers appraise all damages. An act of April 8, 1868, forbids any one to bring into the State, or to have in possession, any Texas, Cherokee, or Indian cattle. Transportation on railroads through the State is not forbidden, nor the driving through any part of the State of such Texas or southern cattle as have been wintered at least one winter north of the southern boundary of the State of Missouri or Kansas. The penalty of violation is a fine not exceeding $1,000, or imprisonment in county jail at the discretion of the court, not to exceed six months, together with all damages that may accrue by reason of such violation of the law. Any one driving or importing diseased sheep into the State, knowing the disease to be contagious, is deemed guilty of misdemeanor, and is punishable by fine of not less than $50 nor more than $100. The same fine is imposed upon any person who may turn out of his inclosure, or sell sheep, knowing them to be diseased.

In Kansas when a majority of the electors in any township petition county commissioners for orders to confine animals during the night-time, such orders shall be made and notice thereof given. The owner is liable for depredations of animals during the continuance of such orders, without regard to condition of fences. Persons damaged in their property have a lien upon the stock. If any stallion or jack over the age of two years is found at large, the owner, if known, must be notified of the fact; and if he fails or refuses to confine the animal he is liable to a fine of $5 for the first offense, and $10 for each subsequent offense, and all damages. Stallions and jacks, not used for breeding purposes, may be castrated by the person taking them up, if the owner fails, after three days' notice, to reclaim the same, and pay damages, or such animals may be killed after six days' notice. Any bull, boar, or stag found running at large may be taken up at any time or place. Electors of townships may decide whether swine may run at large or not, at least ten voters having petitioned for the submission of the question. No horse, mule, or ass diseased with glanders is allowed to be at large, under a penalty of not less than $5 nor more than $100. Knowingly to import or drive into the State sheep affected with contagious disease is a misdemeanor, with a fine not to exceed $200. The same penalty is provided for any owner allowing such sheep to run at large, together with responsibility for damages to other owners. Rams must be restrained between June 15 and December 15, under penalty of $5 for each day allowed at large. Electors of townships determine whether or not sheep shall run at large. In February, 1867, a sanitary measure was passed for the protection of cattle from the ravages of the Spanish fever. Stock from Texas and the Indian Territory brought into the State between the first day of March and the first day of December in any year, are not to be driven through the State except in the remoter parts on the plains, and then not within

five miles of any highway or "ranch," except by consent of the owner of the latter. Violation of the law is treated as a misdemeanor, and the first offense is punishable by fine of $100 to $1,000, and imprisonment from thirty days to six months; for subsequent offenses the penalties are doubled.

In Nebraska cattle and other stock are restrained in particular counties. The legislation concerning cattle, &c., is also of a local character in the State of California.

The laws of Oregon interdict the running at large of any stallion, jack, or mule, over eighteen months old, within the months of April, May, June, July, September, and October. If not kept for breeding purposes, the animal may be gelded. If kept for breeding purposes, the distrainer may return him to the owner, and recover $2. The owner of such an animal is liable for damages. Animals affected with contagious diseases must not be brought into the State under a penalty of not less than $50 nor more than $500 for the introduction of each animal so diseased.

VINELAND AS A LESSON IN COLONIZATION.

Whatever may be said in praise of the site and soil of Vineland, or in depreciation of the productive value of "New Jersey sands," there can be no question that this colony of ten thousand people, gathered within a period of ten years, as a settlement almost purely agricultural, has furnished an example in colonization which should not be ignored, and which may prove suggestive in the organization of agricultural settlements in other portions of the country. Its peculiar features, its points of successful accomplishment, even its very failures, may be made subservient to the uses of colonization elsewhere. It tends also to show that restrictive legislation, in the interest of rural æsthetics and public morals, may be practicable and beneficial in a community in which the public sentiment is almost unanimous in its favor. It affords a striking example of the effect of population, of educational and social advantages, of associated improvement, in enhancing values of real estate, and creating a market even amid a community of producers nearly homogeneous. It furnishes a practical rural illustration of the adage "In union there is strength." Yet the lesson inculcating the superior economy of a nation of farmers cannot be drawn from this community of tillers of the soil. But for the millions of consumers in New York and Philadelphia and other adjacent cities, a city of producers of small fruits and perishable vegetables would be impossible.

It is deemed proper to present a brief view of the history and progress of this settlement, in the words of the writer, Philip Snyder, (president of the Vineland Agricultural and Horticultural Society,) without officially indorsing or dissenting from any of the facts presented:

The county of Cumberland, in which Vineland is chiefly situated, is naturally, in soil and climate, one of the finest in New Jersey. The surface is undulating, somewhat resembling the prairies of Iowa. The soil is almost entirely free from rocks or large stones, and of a mechanical texture admirably adapted to working. While popularly accounted "light," its proportions of clay, loam, and sand are such as to produce the finest crops of cereals, fruits, and vegetables. Twenty to thirty bushels of wheat, fifty to seventy-five bushels of corn, or one to two tons of hay per acre are common crops in fair seasons. The soil rarely bakes, or needs underdraining. It admits of deep working, and responds readily to the application of manures.

Vineland lies along the eastern limit of Cumberland County, thirty-four miles south

of Philadelphia, and extends for a short distance into the counties of Atlantic and Gloucester. Its latitude is thirty-nine degrees twenty-eight minutes north, and it is distant nineteen miles north from Delaware Bay, and thirty-two miles west from the Atlantic Ocean. The elevation is one hundred and eighteen feet above tide water at Philadelphia. The breezes from the bay and ocean relieve the summer temperature, while that of winter is modified by the proximity of the Gulf Stream.

Previous to the opening of the West Jersey railroad, which now traverses Vineland, this territory was a neglected wilderness. For this there were two principal causes: First, the isolation of the region; second, ownership, in large tracts, by wealthy proprietors, who had little disposition either to improve or to sell it. The taxes were nominal, and the revenue from timber, charcoal, and fuel, (the latter for the glass factories at Millville and Glassboro',) was an item of at least some value. When the opening of the railroad made the tract easily accessible, Richard D. Wood, who owned the larger part of it, began to look about for a customer. Charles K. Landis, who had some previous experience in colonization, and had recently been through the West with the view of founding a new colony, first visited the place in February, 1861. Satisfied that its natural agricultural capacities were not inferior to the remainder of the county, and that, by a suitable system in colonization, which should look as much to the good of the settlers and of the county as to his own profits, he could soon attract a prosperous colony, he purchased 16,000 acres, and afterward, from time to time, 14,000 more. He took possession the following summer, and began the formal opening of the work on the 8th day of August.

THE SOIL.

Of the peculiar characteristics of the soil of Vineland, Dr. Charles T. Jackson, of Boston, the state assayer of Massachusetts, thus records his observations:

"The soil of Vineland is an ancient sea-bottom of the cretaceous age; that is, it belongs to the same formation as the chalk of England and France, as is proved by the characteristic fossils. There is, as the base of this formation, an extensive tract of green sand, known in New Jersey under the name of green-sand marl. This deposit extends across the Delaware River into the State of Delaware, and it undoubtedly underlies the country from Vineland to Hammonton, and probably extends much farther in different directions, though at a considerable depth from the surface. Thus, in this county, marls and clays represent the chalk of England and France, the conditions for the production of chalk not having existed on our shores at the time of this formation.

"On the immediate surface there is a thin covering of tertiary deposits, derived chiefly from the débris of the previously deposited chalk formations, abundant broken fossils indicating this fact. It is also remarkable that the fine, yellow subsoil of Vineland has the same concretionary structure as the green-sand, so that it appears as if composed of that substance, altered by decomposition, protoxide of iron having become peroxidized, and much of the potash washed out by the action of the water.

"The fine soil certainly bears no marks of its being formed by the coarse operation of disintegration of rocks, for it is so fine that when mingled with water it is kept suspended in it a long time, and when thrown in a filter some of the soil passes through the pores of the paper, indicating extremely fine division.

"Experience has shown that all the crops which have been cultivated in Vineland have done well. The roots of vines and trees extend to a greater length than they do in a heavy or clayey soil, and this gives to those plants an additional security against drought.

"There is some white sand washed up by rains, but it does not the least harm, and there is fine, rich loam enough in the soil for all the needs of vegetation. The land is well drained, and is somewhat rolling, though not hilly. There is very little decaying vegetable matter, and but few tracts of swampy land, and nowhere any stagnant water. With these conditions, I should regard the place as remarkably salubrious, and not liable to miasmatic diseases, even were I not credibly informed that Vineland is free from them. The winds from the south and the east come over the sea water, but in their passage over twenty to thirty miles of land lose their chilliness and excess of moisture, while the winds from all other directions blow over a great extent of land, the north and northeast winds being much tempered thereby, so as to be comparatively mild. Such a situation insures an invalid a mild and equable climate, while it proves healthful to the laborer."

Dr. Jackson made two analyses of the surface soil, and from these combined he gives the following as the composition of the soil:

Vegetable matter [humus]	5.800	Phosphoric acid	0.056
Silica	78.600	Potash and soda	1.814
Alumina	10.000		
Peroxide of iron	2.800		100.000
Lime	0.540		
Magnesia	0.390		

He adds: "Phosphoric acid, lime, the alkalies, and vegetable organic products are the most essential elements of a soil, and these are present in the loam of Vineland."

PRINCIPLES OF SETTLEMENT.

The principles of settlement adopted by Mr. Landis embrace the following particulars:

1. The sale of lands with stipulations for immediate improvements.
2. Division into small farms of twenty to sixty acres, with convenient access to roads; and the encouragement of fruit growing and gardening in connection with general farming.
3. A general system of public adornment, tending to still further æsthetic improve ment as wealth and public taste increased.
4. The prohibition of the sale of all intoxicating drinks as a beverage.
5. The abolition of the system of fences, with a view both to beauty and economy.
6. The establishment of a city in the business centre of the tract, which should be supported by manufactures and schools, and which should furnish, to a considerable extent, a home market for the surplus products of its suburbs.

The principles thus set forth justify notice in detail:

1. The first condition was designed to prevent the holding of land for merely speculative purposes, as well as to make every purchaser a contributor to the improvement of the whole settlement. Had this feature been neglected. the progress of the settlement would have been slow, or its prospects entirely destroyed. The influx of a considerable population would have been the signal for a rush of speculators who would have bought up the land in large tracts, and held them without improvement, merely to secure the benefit of the improvements on neighboring lands. As the settler improved his place he would find adjoining lands rising in price, merely on account of his industry; while the enormous prices asked for unimproved lands would deter new settlers from buying, and discourage the whole settlement. Every buyer of new land binds himself to erect a dwelling, to clear up and cultivate not less than two and a half acres, and to make his roadside improvements within one year, or he cannot receive a deed for his purchase. If he fails to make these improvements within the specified time, and there is no prospect of his making them, the land is resold to other parties on the same conditions. In addition, the law incorporating the township authorizes the township committee to enforce the roadside improvements by suits and fines, so that all lands in the township two years after being cleared must share in the general roadside improvement.

2. The division into small farms was specially important to the success of the enterprise. Pioneers are usually men of limited means, and larger farms would be of no practical use to such persons. Besides, for fruit culture or gardening, a concentration of labor and capital is essentially important. Another consideration was that small farms would secure a dense population, which would furnish the opportunity for the highest development of social, mental, and religious culture. It was thought that in such a community, under the indicated conditions, small farms well managed could not fail to appreciate in value; that they would furnish attractions to the better class of capitalists, to scholars, to men of leisure and culture, to patients in search of health, and to all capable of enjoying homes in a rural region where growing families could be reared at a distance from city vices and temptations. To these classes the original settlers could sell at a paying advance, and as long as the tract furnished unoccupied lands they could buy again, and start under more favorable circumstances. As population, manufactures, and business increased, the area of cultivated lands in the central portions would diminish, and the value of the home market, as well as of the surrounding farms, would increase in proportion. Such has actually been the result. Probably in no other place in this country, not sustained by commerce, mining, or trade, has property appreciated so rapidly, and probably in no other rural community is so high a standard of morality and intelligence maintained. The division into small farms, and the practice of fruit culture, or gardening, in connection with grain or grass growing, with the encouragement given to the best systems of culture, were essential to this result.

3. The system of public adornment, while comparatively inexpensive, is, next to the absence of fences, the most marked feature that strikes the stranger's eye. The roads are laid out with a special view to convenience and beauty. The old roads were merely winding wagon tracks through the forest, the bushes often scraping the wheels; the new roads are straight, generally parallel to one another, from fifty to one hundred feet wide, and cross one another at right angles. The West Jersey railroad traverses the settlement in a nearly north and south direction, and on each side of the track one hundred feet are reserved for a boulevard with two rows of shade trees, making four rows of shade trees within less than one hundred feet of the track. The village is located about midway between the north and south lines of the track, on both sides of the railroad, with right angled streets, each from sixty-six to one hundred

feet in width. The road beds are generally thirty feet wide, and are handsomely graded as fast as the needs of the settlement require, and the remainder of the space allotted for highways is seeded to grass, and one or two rows of shade trees on each side, not more than two rods apart, must always be maintained. Either fruit or ornamental trees will answer the requirements. Two rows are requisite on each side of such roads as are one hundred feet wide; those from fifty to sixty-six feet wide have a single row. Pestilential weeds, such as thistles, wild carrots, &c., must be kept down. The grass along the roadside, as well as the root or grain crops now and then grown for a rotation, belongs to the owner of the adjacent lands. As the trees advance in size and age the effect of this system will become more and more apparent, and the value it will impart to property will be no less marked.

Another result of the system is the effect on public taste. Some persons perform this work unwillingly at first, but seeing its good effects all around them they are frequently led into more adornment than the law requires. The trees at first may be inferior, but these gradually give place to a better class, the number sometimes being doubled, and then nicely graveled side-walks follow, bordered by beautiful hedges. Could an accurate computation be made of the number of miles of young evergreen and Osage orange hedges already planted in Vineland, the amount would astonish one unacquainted with the place.

A public park of forty-five acres, just outside the present village site, and covered by a good growth of timber, and ten or twelve small squares located at prominent road crossings, constitute a part of the system of public adornment. These are a free gift to the township from the founder, he requiring only that a small sum shall be annually expended upon them to improve and keep them in order.

4. The prohibition of the traffic in intoxicating liquors is designed in part for pecuniary profit, as well as for social and moral good. The principle of abstinence from intoxicating beverages has now so many advocates that a place in which the sale of liquor is prohibited, both by law and public sentiment, would naturally attract many who desire homes not exposed to the influence of this traffic. The rights of persons and property are more likely to be respected in such a community, while the advantages for rearing and educating children without exposure to evil influences would naturally attract the better classes from abroad. There could be little taxation for pauperism, or for the prosecution of crimes inspired by liquor drinking; hence there would be a substantial pecuniary advantage. All this Vineland has realized, and the good results are so apparent to her citizens, that at each township election since the question of license has been submitted to the people the vote has been unanimous for prohibition. Even persons with drinking habits, or those whose consciences would not prevent them from selling liquor were it lawful or safe to do so, are so impressed with the advantages of prohibition to Vineland, that even a secret ballot furnishes no temptation for impeaching its wisdom.

5. The abolition of laws requiring the establishment of fences was intended to promote both economy and beauty. Every settler is at liberty to build fences if he desires it; but where the land can be tilled it is an ascertained fact that the soiling of stock is more profitable than pasturing. To carry out this change in regulations it was only necessary that a law should be secured to prohibit cattle from running at large on the highways. This was done in the face of some opposition from the few farmers inside and outside of the tract, with whose habits this law would interfere. At first it was disregarded; but the killing of some cattle and the impounding of others, with fines and penalties, soon disarmed opposition, and universal obedience is now the rule. The immense outlay saved the settlement by this enactment will be partially appreciated by a moment's consideration. The length of the various roads on the tract now amounts to 160 miles, or 51,200 rods. The fencing required on both sides of the roads would be 102,400 rods in length. At the low estimate of $2 per rod, the total cost of these roadside fences would be $204,800. The addition of line fences between different owners would doubtless require five times this expenditure, so that by dispensing with fences at least $1,000,000 has been saved the settlement, without taking the item of repairs into the account—an outlay which would have proved a heavy burden upon the enterprise. Hedges and screens are a voluntary matter. The first cost of the plants is small; the care required to grow them is also small; and when grown they are permanent, and constitute lines of beauty which never tire the eye of taste. Age adds to their beauty, strength, and usefulness; and a few years hence it is more than probable that Vineland will present the most remarkable instance of rural æsthetics on a grand scale that this country, if not the world, can exhibit.

In the village plat every house must be located not less than twenty feet from the outer line of the street, and in the country, seventy-five feet. This is done to give opportunity and encouragement for the planting of flower gardens, shade trees, and shrubbery, and the laying out of lawns. The result constitutes an important feature of the landscape as the stranger rides through the place.

6. The Maurice River, only two miles from the station, furnishes an immense water-power, and about twenty mills, at various points on this never-failing stream, including

at least one large cotton factory, have long been in operation. Of manufactories not depending on water-power there are already perhaps more than the number common to thriving villages, embracing those relating to clothing, boots and shoes, lumber, wood-turning and scroll-sawing, buttons, straw-sewing, basket-making, bricks, earthenware, sashes and blinds, doors and window frames, planing-mills, flouring-mills, bakeries, book-binding, fruit-baskets and boxes, with several propagating houses for flowers and plants. For schools, the good order of a moral and intelligent community, a climate not subject to extremes or malarious diseases, and a close connection with the great railway system of the east, furnish unusual advantages. Vineland possesses a successful academy and fifteen public schools, attended by 1,500 pupils, and the Methodists of South Jersey have located a large seminary here, to cost at least $50,000. Many inducements were offered to secure the location of this seminary elsewhere, but the committee in charge gave Vineland the preference because of its temperance principles, and its present and prospective attractions for parents who desire to educate their children under the best moral influences. The seminary will be opened to the public in 1870.

RESULTS ATTAINED.

Some of the results connected with the settlement of Vineland have been incidentally referred to in the foregoing exposition of the principles on which it is founded. Others will be briefly noticed.

The Vineland tract, by which is meant simply the area covered by the various purchases of Mr. Landis, extends over about 30,000 acres. Landis township, as incorporated, covers about 44,000 acres. Before the West Jersey railroad was opened the region generally was worth what it would net from wood, lumber, and charcoal; and it is stated that not many years ago $5 per acre would have purchased any quantity of land in the neighborhood of the present depot. The lowest price at which village lots can now be purchased is $150 per lot, the lots measuring 50 feet by 150, or a little more than one-sixth of an acre. This is at the rate of nearly $900 per acre. On Landis avenue, in the business portion of the village, $40 per linear foot have been paid for building sites, a rate exceeding $11,500 per acre. Over four hundred acres out of the six hundred in the village are now improved. Good fruit farms within a mile or so of the village, with respectable buildings, bring $500 to $1,500 per acre. Besides the 44,000 acres in Landis township, there are, in the portions of Franklin and Buena Vista townships belonging to the tract, perhaps 6,000 acres more. Estimating these 50,000 acres—village and all—at $150 per acre, we have a total of $7,500,000 as the present value of a territory which in January, 1860, could not probably have been sold for $4 per acre. This advance has been gradual, and attended by no violent fluctuations. The completion of the Vineland railway to New York will enchance existing values, for then the surplus productions of the place will have a safer and surer market. The amounts of some of these surplus products, marketed in 1869, were as follows: Strawberries, 209,844 quarts; raspberries, 39,962 quarts; blackberries, 132,353 quarts; Peaches, 7,904 packages; melons, 629,470 pounds; grapes, 254,203 pounds; sweet potatoes, 5,678 barrels. As 10,000 to 12,000 people reside on the tract, this table is far from showing the actual production. The sweet potato shipments are only to November 4. Considerable quantities have been shipped since then, and a dull market induced some of the largest growers to hold over the bulk of their crops for the spring trade. Of berries considerable quantities were made into wine, particularly blackberries, as the immense peach crops all over the north so occupied the markets as to make a part of the blackberry crop unsaleable. The pear and apple orchards are yet too young for any considerable crops, but both the fruit and the trees give promise of the highest success. The same is true of plums; the trees grow thriftily, the black knot has not made its appearance, and wherever due diligence has been shown in fighting the curculio the result has been entirely satisfactory. The interest felt in pomology and horticulture has been greatly strengthened by the formation of farmers' clubs in all the neighborhoods of the tract, holding weekly meetings for discussion and the dissemination of information. The oldest club of this kind, the Vineland Agricultural and Horticultural Society, was organized in June, 1863, and since that time, besides an annual fair for five years past, it has held weekly discussions winter and summer, with little interruption. General farming receives a due share of attention at these meetings. Occasionally a settler prefers general farming to fruit culture or gardening, and as farm crops after clover succeed well, there is no doubt that land can be profitably employed in this direction, but near the station it is worth more for fruit culture. One gentleman who, in 1868, planted three to four acres in corn, on a clover sod, and obtained a yield of seventy-five bushels of shelled corn per acre, stated that the land was worth more for sweet potatoes. The latter have been grown in some cases at the rate of three hundred bushels per acre. The pecuniary results, however, of any crop grown in Vineland, depend, as elsewhere, on the cultivator's skill, judgment, capital, and energy. High culture, which may be defined as the greatest profitable amount of labor and capital applied to the smallest area, has the same relation to success here

that it has in other places. One serious drawback to the full development of the resources of the soil has been the want of experience among settlers, a not uncommon want with all pioneers. Another drawback is that, as in all new places where real estate is advancing in value, certain classes are attracted who hope in some way to be benefited by this rise with little work on their part. When these are sifted out and the population settles down to its real work, the period of highest success will begin.

SOCIAL FEATURES.

The social and intellectual results developed in the growth of Vineland also deserve attention. Its citizens being chiefly of New England origin, reproduced in their new homes at an early date the societies, institutions, &c., that have marked the progress of New England. Mr. Landis has also done much to foster and encourage every work which could make life in Vineland attractive to the varied tastes of an intelligent and moral community. To the various church organizations he donated building sites, and $250 for each church edifice as soon as work was commenced. At present there is a Presbyterian, a Methodist, an Episcopalian, a Unitarian and a Baptist church. These are all strong in numbers, while there are small organizations of Second Adventists, Roman Catholics, and Swedenborgians. At North and South Vineland there are also several church organizations. School-house lots have also been donated. Besides religious and educational societies, nearly all the other organizations common to older settled places are in full vigor, among them a Library Association, Historical Society, Young Men's Christian Association, a lodge of Free Masons, several lodges of Good Templars, several musical societies, a gymnastic association, &c. To the instruction and entertainment offered by these organizations are added occasional lectures and concerts, such as are usual in large villages. Two weekly newspapers are published, one printed by steam, besides several advertising sheets issued at irregular intervals. The growth of manufactures has already been noticed. In fact, a stranger coming to Vineland without some knowledge of its history would not dream, from the ease with which his wants may be supplied, that every foot of the land he treads has been redeemed from a wilderness in eight years, and that every evidence of thrift and civilization about him has come into being in that narrow period of the life of a town.

COPYING THE VINELAND PLAN.

At the first glance it might be supposed that the Vineland plan could be copied and applied for the purposes of future settlements. But a second thought will give the conviction that this can be done only to the same extent that one man can exactly follow the plan of another and achieve his success in business. The conditions of success are never exactly alike. A slight difference in climate, soil, markets, facilities for obtaining fertilizers, in the condition of the surrounding country, and perhaps more than all, in the organizing and executive talent of the founder, may make a wide difference in the result. Nor would enterprising and moral people desire to settle in a sluggish, boorish, or immoral neighborhood; an uninhabited wilderness furnishes a better opportunity for starting aright. Some future colonizer may yet surpass all that has been done in Vineland, but it will not be accomplished by mere imitation. Some of the details of the Vineland plan might be of great service in future settlements; for instance, the improvement stipulations, the outlawry, respectively of the liquor traffic, of land speculation, and of cattle ranging, and the enforcement of the system of roadside adornment. Proper organizing and executive talent should lead in these enterprises of colonization; but the difficulty is that such talent is not always readily found.

VALUE OF THE EXAMPLE.

Vineland has demonstrated that the colonization of neglected tracts in the Eastern States and along the Atlantic coast can be made remunerative to all concerned when capital, skill, and judgment are employed. The benefits arising from this enterprise are not to be measured by present pecuniary gains. Far greater than these is the value of the example, thus furnished, of order, beauty, and morality as aids in colonization, and as contributors to the happiness of a large and thriving community. The success of Vineland is suggestive of the better maintenance of a just balance between city and country. It is but natural that enterprising young men should find few attractions in regions of large farms and careless culture, and of sparsely settled neighborhoods where social and intellectual privileges are relatively small, and where attempts at rural beauty are regarded as misspent labor. It is but natural that when not possessed of capital they should fly from these surroundings, and seek their fortunes in the cities. Small farms, fruit culture, or thorough culture applied to any crop, rural charms and the social advantages of a populous and intelligent neighborhood, will serve to retain thousands of young men in the country who would otherwise enter the cities, too often to their ruin. Such considerations are sufficient to commend the Vineland enterprise to the earnest sympathy of every well-wisher of his fellow men.

THE AMERICAN INSTITUTE FARMERS' CLUB.

The association bearing this name holds a meeting on Tuesday of each week in Cooper Buildings, New York, which is free to the public, and extended reports of its proceedings are published in several prominent papers both in and out of the city. Nathan C. Ely is president, and John W. Chambers secretary. The list of regular attendants includes the names of gentlemen well known in connection with agricultural and horticultural literature and science. Strangers, practical farmers from the country, are also frequently to be seen in the audience, and they often participate in the discussions; but a unique and most important feature is the mass of letters received from every section of the United States, averaging in the aggregate from five to ten thousand per annum. This correspondence contains accounts of experiments and bits of experience which excite comment, and call forth questions which are generally answered by some one present. In this way great numbers of tillers of the soil have learned to regard that club, to a certain extent, as their own; to feel a sort of personal interest in it, and thus, with the help of the press, it is exerting an influence worthy of consideration in making up the schedule of ways and means which are advancing the standard of American agriculture.

We present a few pages of condensed report which may give an idea of the character of the proceedings, and serve as a criterion by which to judge the tenor and tone which for the time characterize the thinking of the better class of our farmers.

GRAPE-VINES FROM LEAVES.

Mr. Harris, of West Virginia, forwarded a statement to the effect that certain grape-vines were grown from leaves. "The leaves being stripped from the vines, and placed in sand prepared for them, the bud and roots started out from the stem of the leaf." The process is to "take the leaf, and give a quick downward jerk. This breaks it off close to the vine. It is then put into the sand for about fourteen days, at the end of which time it will have roots and top started. Then it is potted and grows rapidly."

PEDDLING STRAWBERRIES.

A Wisconsin correspondent, who lives twenty miles north of Madison, wrote to inquire if strawberries may be profitably grown so far from market. Mr. Meeker replied with reference to a man in Northern Ohio, thirty miles from any town, who went to work to raise a crop of strawberries, and succeeded far beyond his expectations. When the fruit was ripe he filled his wagon and went about the country peddling. He sold twenty bushels per day at a quarter dollar a quart. "The fact is," concluded the narrator, "the people generally do not have strawberries, and are willing to buy."

THE PRODUCT OF A SINGLE PLANT.

A correspondent wrote to say that in 1863 he received a single strawberry plant which multiplied to such extent that during the past season he sold from it thirty dollars' worth of fruit at twenty cents per quart, and forty dollars' worth of plants at the rate of four cents each. In addition to this, thousands of plants were given away.

EIGHTY PLANTS ENOUGH.

Mr. Nutter, of Massachusetts, made a note of success which he thought might serve to encourage those who, living in towns or city suburbs, neglect to get a bed of strawberries, because the plats are small. He said:

"Rev. T. O. Paine, of Joppa village, set out, in the spring of 1868, eighty plants of the Wilson variety, in hills twenty-two inches apart, first trenching the soil to the depth of two feet or more, and applying a liberal quantity of stable manure. The runners were kept pinched off, and the ground was mulched in August with a thin layer of newly cut, fine grass, and again at the approach of winter with a good cover of small hay. He picked, by actual measurement, ninety-one quarts of nice strawberries, an average of one and one-eighth quart per plant. The same number of plants in another bed, treated in the same manner, but not manured, yielded less than half the quantity mentioned."

AN ASTONISHING APPLE TREE.

Mr. Boutillier, of New York, vouched for the truthfulness of the following story: In the orchard of Mr. Arnel, near the village of Belle River, New Jersey, is a very singular apple tree. At the time of writing, July 26, this tree had apples upon it nearly full grown. The blossoms of these appeared at the usual season. On the same branches was another set of apples, less advanced, from blossoms which appeared in June; while the wood that was grown last spring was covered with blossoms which Mr. Arnel thought would in due time ripen into good apples. He further stated that the tree would have another set of blossoms in August. The apples are all of the same kind and of good quality, the only difference being in the time of ripening. The tree is remarkably fruitful, and keeps along in this way of bearing from year to year.

NEGLECTED APPLE TREES.

Dr. Smith read an essay on this subject. He excepted to the impression that apple trees have become fatally diseased, and that this accounts for their meagre yield and imperfectly developed fruit. He believes there is unnecessary alarm, and that neither the cause mentioned, nor the insect ravages are so far beyond control as is frequently represented. Apple trees ought to bear until they are nearly a century old; and they would do so if the same care were bestowed upon them when old as when young. After a few years pruning is quite omitted. The limbs multiply until the top becomes a compact net-work, excluding the sun's rays, and affording secure burrowing places for vermin. Next, from long neglect, especially of old orchards, the foot of the tree becomes grass bound. The snug fitting turf is like a ligature, and besides interfering with the free circulation of the sap, it affords a nestling spot for such insects as feed upon it. The remedy is as simple as the fact is apparent; remove all such intruding embarrassments by keeping the ground free from weeds and hard wiry grasses. Dr. Smith then alluded to certain discoveries which would seem to establish the fact that animal remains are particularly beneficial. For example, trees of an ornamental character in cemeteries are usually more thrifty than the same sort in other localities where animal products are not accessible to the roots. The coffin which originally held the body of Roger Williams was, as is well known, so completely invaded by the roots of an apple

tree that the entire anatomical shape, position, and dimensions of his bones were secured by the tendrils, and the cast of that celebrated man's skeleton, thus taken in an unheard of manner, is at present a museum curiosity. In alluding to the inevitable curculio and how to manage it, Dr. Smith advised that swine should have free access to the orchard. In conclusion, he said that the care and renovation of orchards demand active personal effort; and he regarded it as inconsistent with the intelligent course pursued in regard to crops in general, and with the humanity of the age in the kindness manifested toward domestic animals, that fruit trees should be so entirely neglected.

SPARROWS AND CURRANT BUSHES.

A member wished to know if these birds would protect currant bushes from the ravages of the currant worm, (*Abraxas ribearia*,) and, if so, where they can be procured. Mr. Cavanach replied:

Sparrows are no protection for currants. A better way is to go through the garden with a flock of young chickens. Then jar the bushes, and let the chickens catch the worms as they fall.

CRANBERRY CULTURE.

Mr. Ridgeway, of New Jersey, forwarded an extended communication containing some ideas upon cranberry culture, at variance with certain statements which have been accepted as well-established facts. In the first place he announced that the majority of cultivators in his State have not yet raised a second crop of cranberries; and that, therefore, their opinions are of less value than they may be after more extended experience. In regard to muck he said that none but that of cedar swamps has ever been found valuable in New Jersey, and that other kinds yield as well as loam and no better. The second requisite is fine sand, at least five inches of which should be applied to the surface; third, thorough drainage; fourth, entire command of water for flooding; and fifth, the right kind of plants. In Ocean and Burlington Counties three-fourths of the bogs will be total failures in consequence of the owners having rushed into the business without information of the necessities of the case. Still, if a person informs himself, and secures a good bog he is certain of permanent success, because good bogs never fail, though the crops may vary.

PIE PLANT POISONING SWINE.

Mr. Passmore, of Pennsylvania, wrote that he prepared for market twenty-five bunches of common rhubarb by stripping the leaves from the stalks. These leaves were thrown to the hogs. The result was that five out of the nine died, three were convalescent at the date of the letter, and the other was in a doubtful condition. Those that died gave every symptom of having been poisoned.

THE MERCER POTATO.

Fine specimens of this variety of the potato were forwarded by Mr. Jessup, of Long Island. He got his seed from Maine, and found that the yield was at the rate of 325 bushels per acre. This success had been going on for four years, while at the same time the seed of the old Mercer rotted invariably. Dr. Trimble expressed himself delighted with

this information, and asked: "If we can get the Mercer back again, who wants to pay $50 for new-fangled sorts?" Dr. Hexamer said that thus far it had not been found profitable to attempt to perpetuate the old kinds. No one would speak ill of the Mercer, except that it got in the way of rotting, and so newer candidates took its place. Whether the transfer of this or other varieties from one section to another, or from one class of soil to another, might operate in preserving the produce from decay, was a very important question. The speaker quoted instances where the tuber improved vastly by being transplanted from one soil to another, and he also alluded to instances where just the reverse was the result. As a general thing he believed that the transplanting of a potato from a heavy soil to a light friable one tended to improve the quality. To be sure there was no use in trying to raise potatoes from $50 seed, if Mercers could be made to yield generally as largely as stated; but, if a $50 seed would give a fine healthy potato instead of a sickly one, then the money was well expended.

CARE OF SWEET POTATOES.

Mr. Carey, of Ohio, wrote to say that he preserves his sweet potatoes by placing them in bulk in a bin or box (the more the better) without drying, and maintaining for them a uniform temperature of 45° to 50°. Putting something between, among, or around them may serve to keep them at the proper temperature, but it is of no value whatever aside from this; and if it should retain dampness, it will be a positive injury. After the sweat takes place, say in three or four weeks, scatter over them a light covering of dry loam or sand. In this way it is easy to keep sweet potatoes for table use or for seed, as well as "the inferior and less nourishing Irish potato." Mr. Dutton, of Missouri, also gave his method. He packs in barrels, and pours in kiln-dried sand until the intervals are full. Sometimes he uses boxes of uniform size, piled up on the side of a room where the temperature never falls to the freezing point, which is a condition of first importance. This wall of boxes may be papered over, and left undisturbed till spring, when the potatoes will command the highest prices. Mr. Quinn remarked, in the course of a brief discussion which followed, that, if the southern cultivators could only see a way of making this tuber an article of commerce, many millions of bushels would be grown annually. Professor Whitney suggested desiccation, and alluded to some experiments which serve to show that the dried sweet potato, properly prepared, is capable of being used to a very great extent as a substitute for ordinary flour. This invention or discovery is yet in the germ, however, and before practical results can be realized, the processes involved and the methods of using the product for various purposes in cooking and bread-making must be improved and popularized.

LARGE WATERMELONS.

Mr. Stanley, of South Carolina, gave his plan for raising watermelons which weighed from twenty-five to forty-five pounds apiece. Holes are dug two feet square and eighteen inches deep, twelve feet apart, filled with fresh stable manure tramped down, the surrounding soil drawn over; or, better still, fresh soil from the woods or corners of fences, mixed with road sand. Make the hill of the shape of an inverted saucer, a little well-rotted manure or guano being slightly raked in, and some coal dust applied to absorb the sun's rays, which also prevents a

crust from being formed. Let no grass or weeds appear, and never disturb the vines when the dew is on them. The best varieties are the Orange, Bankright, and Bradford.

A PLEA FOR THE SUGAR MAPLE.

Mr. Hogeboom, of New York, thinks that in regions where the sugar maple grows thriftily it ought to be carefully guarded, and its cultivation encouraged. It is no uncommon thing, however, to see whole groves of the second growth swept away by the ax, and often, too, where the land is of little value for tillage. If they had been allowed to remain, in a few years more, after the winds and other causes had exterminated the maples of the forests, these groves would have become fine sugar orchards, yielding an annual and constantly increasing product of more value than the best crops from the same ground, while the growth of the timber would have paid an interest of at least twenty-five per cent. on the price of the land. As the old forests gradually disappear, these groves would be more and more appreciated, as enhancing the value and appearance of the farm, while eventually they would increase the attachment of the children to the homestead. A tract ever so well farmed, yet denuded of its trees, is wanting in the evidence of high civilization. This, looking only to immediate profit in dollars and cents, is simply a species of barbarism.

MAPLE SIRUP.

Mr. Waterman, of Indiana, contributed the following recipe "for the benefit of those who appreciate the saccharine products of the rock maple:" To preserve the fine flavor, take the sirup made of the first run of sap, and fill good, sweet, sound jugs, cork tightly with short corks, seal and cover the corks closely with wax; then bury the jugs in the ground three or four feet deep, and in a shady place.

LOCUST TREE CULTURE.

Mr. Hallock, of Long Island, furnished a very full account of the experience of a neighbor of his with this valuable timber. He commenced many years ago in a small way, obtaining a few saplings, and setting them here and there, usually where wood had been cut off, in which places it was found they succeeded best. As they grew and threw up suckers these were in turn set out. This process being slow, he procured seed, which was planted in a nursery and carefully cared for. When the sprouts were large enough they were transplanted to land which was generally regarded as worthless, and was slow of sale at $15 or $20 per acre. This was usually overrun with stinted forest growth, which, of course, had to be cut off to make room for the new occupants. At the end of five years another clearing was made, and the locusts, the roots of which are great runners, being now in undisturbed possession, sent up immense numbers of young shoots, so that, where originally set at twenty-five feet apart, they now cover the ground sufficiently to form a thick forest. Many a hard day's work came to naught; ten thousand trees set in one lot of thirty-five acres were all killed by the drought the first summer. Failure strengthened perseverance, however; the next spring ten thousand more were set on the same ground, and now the net result of all this effort is, that land which was bought twenty-five years ago for $20 an acre has upon it now lo-

costs enough to sell for \$150 to \$200 an acre, and still be in excellent condition for another growth. From one lot planted thirty years ago the timber was sold for \$30 an acre, the purchaser doing all the work. In all, he has one hundred acres devoted to this culture, and one of the best things about it all is, that there is an increasing demand for the timber, and that when once planted there is no danger of its running out; on the contrary it is better with every renewal. The locust flourishes on any dry soil, but does best on the site of an old forest, and every rocky hillside can be turned to profitable use by being planted with it. There are two kinds of locust, white and yellow, the white being a great seeder; the yellow seldom seeds much. Persons buying seed would be likely to get that most easily obtained, namely, the white, which is comparatively worthless. Hence it is best to depend on root cuttings.

THE BARBERRY BUSH FOR HEDGING.

Mr. Woods, of New Hampshire, wrote in praise of barberry for line fences, saying that in a moist soil it will grow eight feet high, and the tops will bend over so as to make a beautiful appearance. It is prickly, and will serve well for orchards and fruit gardens, as the boys could not climb over it, and they would not attempt more than once to go through it. It need not be guarded from cattle, as they do not care for it as an article of diet. If a man wishes to divide his pasture, let him plow one furrow, and sow in it three rows of barberry about three inches apart. A dollar's worth of berries ought to serve for eighty rods of hedge. As the berries usually contain two seeds the hedge planted as above directed would probably be sufficiently dense, but if not so, let it be cut down when two or three years old, and then the roots will send up shoots, and in this way the hedge may be made as wide and thick as may be desired. There is no danger of its spreading from the roots, unless the tops are cut. The writer said that there is a bush in his town which he set twenty years ago, and it has not spread an inch. Mr. Fuller remarked: "I said here, long ago, that barberry is the best hedge plant in America. It is better, however, to sow it in the nursery and transplant, than to sow it in the hedge direct."

PREPARING SUMAC FOR MARKET.

Mr. Aldrich, of Rhode Island, gave the following as the New England method of preparing sumac for market. The growth of stalk which has formed since spring is cut before the leaves have turned, and placed in the sun with its adhering leaves, care being taken to protect it from dews and rains, as getting wet injures the value. When perfectly dry it is passed through a hay-cutter, and cut into short pieces, and is then ready for market. The price varies from \$20 to \$50 per ton. Dr. Smith remarked that in Sicily the leaves are discarded, but both the twigs and bark are used, being ground like medicine by an apothecary.

THE IMPORTANCE OF ROOT CULTURE.

Mr. Day, of New Jersey, wrote that, taking into consideration the vicissitudes and casualties of raising grain, coupled with the advanced price of lands at the East, grain-growing and grass-farming must, in a measure, be remitted to the great prairies, and eastern cultivators must begin to give attention to the culture of root crops for fattening pur-

poses. Five pounds of carrots and six pounds of oats have been considered equivalent to ten pounds of oats. The average cost of raising carrots in the old way may be reckoned at fifteen cents per bushel. One thousand eight hundred bushels of mangels have been raised from one acre, at a cost of seven and a half cents per bushel, of which, according to experiment, four hundred pounds were equal to one hundred pounds of hay. Allowing sixty-six pounds to the bushel, the crop was equivalent, in nutritive value, to twelve tons of hay. An ordinary crop of winter cabbages, planted three feet apart each way, will yield 4,785 heads to the acre, which, at the retail price of fifteen cents each, would net $717 75; and even at ten cents, would bring $478 50. Mr. Heberling, of Ohio, wrote on the same subject, saying that, after an experience of more than thirty years in feeding cows and stock ewes, he is convinced that roots—nature's substitute for green pastures—are not appreciated to half the extent they deserve. With one peck or more of chopped roots to each cow, morning and evening, his cows are in as good condition, and yield as much rich milk and butter during the winter and spring as in summer and autumn. Again, breeding from four hundred to five hundred ewes, commencing to drop lambs about the middle of March, he can raise as many lambs as ewes, because there is no starving for want of milk. He finds that one acre of sugar beets furnishes as much food as ten acres of oats, and saves his cows from hollow horn, staggers, abortion, protracted parturition, and other diseases of similar character, which he believes are frequently caused by the feeding of fermented, stimulating, unnatural slops.

PHILADELPHIA BUTTER.

Dr. Trimble mentioned, in the course of a discussion on this subject, that one man in Delaware County, Pennsylvania, cleared $500 in a single year from four cows. They were fed in different pastures, so as to induce them to eat as much as possible. As the grass failed he would feed a little meal. He kept the butter in a spring-house, at a uniform temperature of fifty-five degrees.

DIRECTIONS FOR DAIRYMEN.

Mr. Brown, of New Jersey, wrote advising dairymen to use only shallow pans for milk (the larger the surface and the less the depth the better) and to put into each pan, before straining, one quart of cold spring water to every three quarts of milk. Then, he says, the cream will begin to rise immediately. Skim every twelve hours, and the butter will be free from any strong taste arising from leaves or coarse pasturage. The object of the cold water is evident. It cools the milk, so that the cream rises before the milk sours; for, after milk sours, no more cream will be formed.

PROFIT FROM POULTRY.

Mr. Todd, of Ohio, forwarded some statistics from the account current which he kept with his fowls, fifty-six hens and four cocks, during the year. The eggs netted $148 35; chickens, $100 95; making a total of $249 30. He is not a dealer or believer in fancy stock, but has tried all the approved breeds. The foregoing result, however, may be credited to the White Leghorn for eggs all the year round, and the Brahma for

market and winter laying. His fowls have the best of care, especially during the inclement season. He feeds plenty of grain, meat, and vegetables, not omitting broken bones and shells, and a constant supply of fresh water. The fowls are divided into two or three families, and housed in warm, roomy buildings. In summer they have the range of fields and orchards, and require little or no feeding. Another correspondent, Mr. Hitchcock, of New York, keeps eight hens, and receives from them during the year a net profit of nearly $2 each, no account being made of the value of the droppings as manure. Mr. Lyman gave an account of Warren Leland's success. He keeps great numbers of chickens, as well as turkeys and ducks. They have free range over a fifteen acre "rock lot;" are never troubled with the ills to which fowl flesh is heir, and Mr. Leland says he can raise a thousand or ten thousand pounds of poultry as easily and cheaply as a thousand or ten thousand pounds of mutton, or beef, or pork. Mr. Bruen remarked that one year, with fifty-eight hens and two roosters, he produced six hundred and sixty-seven dozens of eggs. He fed with oats, cooked corn, and cooked scraps; and also gave oyster shells, burnt and pounded, of which they are especially fond. They also had dry sand, ashes, and clean straw. Mr. Noyes, of Connecticut, related some of his experience. His fowls run at large, except during two months of the year, when they are caged, but let out for an hour or two each afternoon. Besides what was consumed by the family, of seven persons, the gross annual receipts from sales averaged, for five years, $3 63 to $3 75 for each of the thirty hens of which his flock is composed.

Another correspondent, Mr. Fitz, of New Hampshire, also furnished some facts relating to his ventures in the same field. He prefers a cross between the "Bolton Gray" and the common dung-hill. He feeds India wheat, and makes the fowls eat it clean. They have full freedom all the year round. He keeps them out of the garden by the crack of the whip-lash. During the year he kept twenty hens, and sold poultry and eggs to the amount of $47 56. The feed cost $14 45, leaving a net profit of $33 11.

GAPES IN POULTRY.

A correspondent wrote to solicit information as to the best preventive or cure of this fowl disease. In reply, Dr. Sanger gave some account of his treatment. A friend of his, whose chickens were dying very fast, permitted him to experiment upon them. "So," said the doctor, "I took a stick of caustic (nitrate of silver) and swept it around the throat inside. It is safe to touch every part. Instead of inducing inflammation, it allays it. Reasoning from analogy, knowing it to be good in similar complaints which afflict the human species, I concluded it would work equally well on fowls." Dr. Trimble said the subject was one of very great importance to farmers all over the country. Probably millions of innocent little chickens perish every year in consequence of the attacks of this destroyer. Therefore he regarded Dr. Sanger's discovery as a valuable one. Mr. Thompson said he used the ounce of prevention, which is to keep the young ones away from the forage ground of the old ones, and never give them raw meal, but feed cracked corn. Mrs. Lyon said the coops should be moved often. Mr. Lyman recommended a mixture of sweet oil, made strong with black pepper. Dip a feather about four inches long in this, and swab the throat of the afflicted fowl. Mr. Todd advised that a horse hair be doubled, and the worms which cause the trouble be drawn out with it.

VERMIN UPON FOWLS.

Mr. Collins, of Pennsylvania, desired information as to the process of ridding a hennery of vermin. Mr. Ely had heard that a liberal use of kerosene about the perches would have the desired effect. Dr. Trimble said: "I had a barn full of hen lice and such vermin, and I fumigated the building with sulphur, using four or five pounds, and the next day the premises were clear, and I have not been troubled since." Mr. Bruen related a similar experience.

THE MINK BUSINESS.

Mr. Stratton, of Tennessee, a gentleman who has been to considerable expense of time and money in studying the habits and experimenting on the practicability of rearing in confinement the mink and other fur-bearing animals, wrote that minks are by nature solitary, wandering creatures, being seldom seen in company, except during the breeding season. It is, therefore, impossible to rear them successfully if large numbers are kept constantly together. The females, at certain times, will quarrrel and fight, and even kill their own and each other's offspring, at least Mr. Stratton has found it so invariably. He thinks, however, that possibly, after a few generations, they might become partially domesticated, and their wild nature, in a measure, be bred out; still, at the beginning, they may, with proper treatment and careful handling, be made to spare their young, even if several are kept together, provided the inclosure is a large one, and has suitable accommodations for feed, water, &c. The male and the female should be permitted to be together frequently from the middle of February until the middle of March. At all other times keep them strictly separate. The young minks make their appearance about the 1st of May. When wild in the woods, they will seldom vary five days from this time, but when kept in confinement there is greater variation. About this season they should have plenty of fine hay, which they will carry into their boxes to make nests. A box three or four feet long and eighteen inches wide is the shape they prefer. It should be placed as far as possible from the water to prevent them from carrying water and mud into it. The young, when first born, are small and delicate, destitute of fur, and resembling young rats. If the mother is tame the progeny may be taken out of the nest and handled when three weeks old. They will soon learn to drink milk, and may be fed each day. At five weeks old they may be put into a pen by themselves, where they will soon become very playful and pretty, and make much better mothers than if allowed to run with the old ones. In conclusion, Mr. Stratton expressed the opinion that minks may be kept "with remarkable profit" in the vicinity of cities or towns, where fresh meat scraps, livers, lights, and all kinds of butchers' offal are easily obtained. "Still," he continued, "the artificial breeding of these and other untamed animals is a new business, and, although there is much money in it, if rightly managed, too great expectations should not be entertained at the outset, because it is a branch that requires special study and experience."

FISH CULTURE.

Mr. Sterling, of Ohio, forwarded the following valuable hints, based on an experience of twenty years:

The amount of water and its temperature are important items in pisciculture, especially in raising trout. The ponds must vary in size, according to the supply of water,

and for raising brook trout the mean annual temperature must not be above fifty degrees Fahrenheit. They will live in warmer water, say sixty-five degrees, but at this temperature cannot be profitably propagated or fattened. At this, or even a higher temperature, black bass will do well, and this fish is superior for the table and for sport even to the trout itself, and may be produced in quantities which will pay better than any other department of farming.

A CURE FOR HOG CHOLERA.

Mr. McDonough, of Illinois, wrote as follows of his treatment of this disease:

In 1861 and 1862, I lost about one hundred hogs. Again this winter my hogs were attacked. I gave a pint of turpentine in one week to fifteen of them, mixing it with slops. Half as much, I presume, would have answered as well. The consequence was they all lived, and are doing finely.

SOW CLEAN SEED.

A correspondent urged the importance of heeding this injunction, saying:

You can get rid of cockle in a single year by the use of a good fan, and in the summer weeding out as much ground as will be sufficient for your seed in the fall. I have a rich soil, excellent for weeds, and some farmers would say, natural for chess, and yet I know by my own experience that I need have neither cockle nor chess in my wheat, if I choose to do without it.

SPARE THE SEED.

Mr. Hamlin, of Pennsylvania, forwarded an account of the success of a neighbor of his with various sorts of potatoes. For example, he planted one pound each of Early Rose, Breese's Prolific, and the Climax, and gathered respectively 196, 116, and 136 pounds. Mr. Fuller remarked that he had received notice that one gentleman got 67½ pounds from a quarter pound of the Early Rose. "These figures," he continued, "suggest the thought that the practice of using great quantities of seed is not the best practice. As a general thing six times as much seed is used as is either necessary or desirable. Sixteen to eighteen bushels of potatoes used to be an allowance for an acre. I do not think that the Rose produces more than the old varieties would produce, provided the latter were as sparingly planted and as well cared for. A man pays a big price for, say, a pound of some new favorite; he cuts potatoes into several pieces, and guards them well all the season through. Let him pursue the same wise practice with the favorites of our forefathers, and there will not be so great disparity in the results." Mr. Bruen said he had found one eye quite enough in a hill. Mr. Gregory said that forty years ago it was the practice to use three bushels of wheat to the acre; afterward it was found that two bushels answered better, and, later still, that a single peck sufficed, and had brought a return of seventy bushels to the acre. He had raised a bushel and a half-peck of potatoes from a single tuber. He thought it would be well for us all to come up to an appreciation of the importance of getting from two acres what we now get from ten. Mr. Fuller said he was firm in the belief that twenty-five per cent. of our agricultural labor is wasted. Of course this is wrong in all respects. Why run over twenty acres for a harvest that might be grown on a quarter of that area, or a half at most? We had better not attempt to make manure for ten acres answer for thirty, or four-inch plowing suffice where sixteen would be shallow enough.

GROUND HAY.

Mr. Kirk, of Pennsylvania, wrote that ground hay, as food for stock, is greatly to be preferred. Ten tons a day can be prepared at a cost of one dollar per ton, and in some instances less. After passing through

the mill it resembles ground oats, and weighs from thirty-two to thirty-four pounds per bushel. Mixed with corn or other grain it makes a cheap and excellent food.

THE HAY TEDDER.

Mr. Hoxie, of New York, inquired in regard to the utility of this implement, and whether or not it would be profitable for a farmer to purchase one when he cuts hay only for a stock of forty cows and a team. Mr. Greeley replied that the general introduction of the tedder would result in large gain to the agriculture of the country. Two notable advantages would be enjoyed, namely: 1. Hay cut in the morning of a clear day could, as a rule, be put on the mow that afternoon; and, 2. The hiding of the sun by clouds would not materially interrupt the process, as active stirring is found to advance the curing very rapidly. In the case of a man who winters the foregoing number of animals, the policy of buying a tedder is beyond debate.

RENOVATING EXHAUSTED LANDS.

Mr. Woodburn, of Ohio, gave his experience in the treatment of a field which had become quite worn out. The soil was a hard clay. He plowed eight inches deep, rolled with a heavy roller to crush the clods, planted corn, and manured in the hill. This brought a thin growth of stalks, and about forty bushels of ears to the acre. He picked off the ears the first of September, when fairly glazed, cut the stalks close to the ground, and plowed them under green. The next spring they were thoroughly scattered. Again he plowed and planted with corn, manuring in the hill as before, and the following September he had the pleasure of plucking ears at the rate of eighty bushels to the acre. Again the stalks were plowed under. The same plan was pursued the third year, and the productive powers of the soil were then found to be fully restored.

WHAT TO DO WITH DEAD ANIMALS.

A correspondent asked for information on this subject. Dr. Smith replied:

> Simply cut the carcass up in small pieces, and place them around the roots of trees, which will be helped in this way more than any other vegetation. This is a direct way, and all manipulation, as of composting, is waste of time.

Mr. Lyman said:

> To illustrate the advantage of animal flesh as food for trees, I may state that, during a late visit to the farm of Mr. Quinn, two pear trees were pointed out, one of which was very inferior to the other in size and thriftiness. On inquiry I learned they were planted at the same time, but it happened that the carcass of a pole-cat rested at the root of the one, while the other was not similarly favored. These two pear trees have been bearing for the past six years; the one yielding one bushel, the other two bushels, a proportion which is likely to be kept up for twenty years longer. This fact shows what a pole-cat may do for a pear tree.

AN INEXPENSIVE UNDERDRAIN.

Mr. Brown, of New Jersey, furnished the following simple directions for making a cheap and durable covered ditch, for the benefit of those who cannot spare the money for more expensive materials. He cut the drain of the proper depth and fall, and laid across the bottom some sticks about the size of a man's arm, a few feet apart. Upon these he placed poles about three inches in diameter lengthwise of the drain, and covered them with slabs, with the edges resting upon each of the poles. He then covered the slabs on the joints and sides with shavings, straw, &c., and filled in all the earth upon them to the surface of the ground. The water flowed freely, and the drain proved effectual.

No draught of air should be allowed to circulate through the drain, as it will hasten the decay of the timber.

COMPLAINT OF "MIDDLE-MEN."

Mr. Danielson, of Iowa, wrote to inquire if there is not some way by which the "poor but honest farmer, who wishes land and a home, may escape the grasp of the middle-men, the land-sharks, those who come between the Creator and the tiller of the soil." He further said: "Land speculators infest every considerable town in Iowa, and whenever a new settlement is forming there they are sure to strike, and thus block further progress unless their coffers are well filled." In conclusion, Mr. D. asked: "Shall the honest yeomanry ever be protected from these scourges?" Mr. King, of Vermont, wished to know if there is not some way by which farmers may escape those who come between the producer and the consumer. "Take, for instance," he said, "our beef. There is the drover with his runners, the butcher, and the stall-man. The result is that the consumer often pays double what the producer receives." Mr. King suspects that by "some possible combination of effort" these things might be better adjusted, but he acknowledges his inability to "concoct any programme of operations." Several members, in comment, suggested that a species of co-operative association might be arranged among the farmers of a neighborhood, electing one or more of their number as representatives or agents.

THE TRICKS OF TRADE.

A letter was read from Mr. Ridge, of Philadelphia, saying that though gypsum is very good for clover land, and it is not objectionable when made into images for Italian boys to peddle through the country, it is scarcely the proper thing with which to fill a horse's stomach. Nevertheless, recent revelations had convinced him that much of the ground feed sold in the cities is composed, in large proportions, of this very ingredient. Mr. Cavanagh thought this was probably true enough, but that there is another side to the story. Farmers are not quite blameless. He had found billets of wood in bales of hay, and tag-locks carefully concealed in fleeces of wool. Dr. Hallock expressed the opinion that the only remedy is to agitate and criticise. He believed that when people err, and their abominable practices are held up to the gaze of the world, they will abandon false balances and unjust measures, and come, in time, to fairer dealing. The Club and the publications of the day ought to be unceasing in their efforts to create a higher standard of business morality. Another member was incredulous, and thought that, so long as human nature remains what it is, appeals to the "moral sense" of fraudulent dealers will prove comparatively barren of good results. Purchasers had better take nothing for granted, but act on the principle that every seller is roguish until known to be innocent.

THE HEMPSTEAD PLAINS.

The chairman called attention to the fact that the well-known merchant prince, Mr. A. T. Stewart, had lately become "a sidewalk farmer," having gone out to Long Island and bought a little patch which he proposes to improve, and Dr. Peck, the champion of that barren land, was asked to give some account of it. In reply, Dr. Peck spoke of the past history of the Plains, saying there had been great misapprehension respecting them. They are not barren, neither are they a dreary dead level, but more like prairie land. They are a hundred and fifty feet above tide-water. They were settled two and a quarter centuries ago,

and have since been held by the town, and the authorities had persistently refused to sell. A gazetteer long ago described the section as a grassy stretch, affording pasturage and very good hay. The soil is dark, and eighteen inches thick. The natural grass often grows five feet high. This is the sort of country now brought so prominently before the public. Mr. Stewart's purchase includes about eight thousand acres, and this he proposes to beautify and convert into a populous tract. Mr. Ely remarked that he looked upon Mr. Stewart's enterprise as a new epoch for the island, and for many people in New York as well.

AGRICULTURAL FACTS OF THE YEAR.

The records of agricultural practice in all its departments for 1869, as officially received from associations and individuals, would fill a volume. A few of the more suggestive and timely statements have been epitomized, and are here presented.

FERTILIZERS.

DISPROPORTIONATE PRICES.

Professor S. W. Johnson, in a paper dated April 10, 1869, reports to the Connecticut Board of Agriculture on samples of sixteen different commercial fertilizers, which samples were obtained in that State, and were mostly taken from the bags and barrels in the stores of dealers. The object of these analyses was to determine the actual commercial value of the fertilizers in question, (some of which have attained a widespread reputation,) basing the estimate on the cost of the active and valuable ingredients as obtained from the cheapest standard source. The current selling prices of the fertilizers are given for purposes of comparison.

Of these sixteen samples, one, a home-made superphosphate, has no selling price affixed. Another fertilizer shows a currency value of $61 52 per ton, against a selling price of $56 per ton. In contrast to this a poudrette exhibited a currency value of only $3 03 per ton, against a selling price of $28 per ton; and another of similar brand a value of only $3 16 per ton, against a selling price of $2 50 per barrel. The estimated value and the selling prices per ton of the various fertilizers are given in the following table:

Number.	Fertilizers.	Commercial value per ton, April, 1869.	Selling price per ton, April, 1869.
1	Fish guano	$30 52	$45 00
2	Baugh's superphosphate	28 67	60 00
3	Stagg's superphosphate	38 12	65 00
4	E. F. Coe's superphosphate	41 72	60 03
5	Russell Coe's superphosphate	61 52	56 00
6	Mapes's superphosphate	35 79	60 00
7	Lodi double-refined poudrette	3 03	28 00
8	Lodi poudrette	3 16	*2 50
9	Saltpeter waste	14 60	35 00
10	Castor pomace	22 33	35 00
11	Baugh's bone fertilizer	18 17	50 09
12	Lloyd's superphosphate	29 04	58 00
13	Wilson's tobacco grower	24 32	80 00
14	Home-made superphosphate	14 42	
15	Bradley's superphosphate	31 81	70 00
16	Atwood's superphosphate	38 26	70 00

* Per barrel.

In the case of the saltpeter waste, certain qualifying remarks of Professor Johnson allow a substituted valuation of $19 50 per ton. In respect to the exhibit in general he says:

The valuation is not intended to fix, in all cases, the proper selling price of a fertilizer. It may, however, always serve for comparing together the money value of two or more manures, and so nearly represents commercial worth that the farmer will not often err in refusing to buy any article the cost of which much exceeds the calculated value.

On this exhibit S. L. Goodale, secretary of the Maine Board of Agriculture, reports that the commercial value of several of these fertilizers should be placed at higher figures. He instances six superphosphates, giving nearly approximate estimates of such prices, taking as a basis certain calculated commercial values of the leading constituents of these fertilizers, viz: Six cents per pound for insoluble phosphoric acid, twenty-five cents for soluble, and thirty-five cents for ammonia.

No.	Superphosphates.	Value.	No.	Superphosphates.	Value.
3	Stagg's	$52 35	12	Lloyd's	$38 77
4	E. F. Coe's	64 10	15	Bradley's	45 66
6	Mapes's	54 66	16	Atwood's	55 49

Mr. Goodale states that to these estimates a small addition should be made for cost of some minor constituents. He also concedes a large additional valuation to Wilson's tobacco grower, yet the indicated value falls far below the current selling price.

DEPRECIATION IN PERUVIAN GUANO.

As the guano of the Chincha Islands is becoming exhausted, a much inferior article is being put in the market to supply its place. For instance, an agent of consignees of the Peruvian government recently advertised two cargoes of guano under the style of "No. 1 Peruvian (Guanape Island) guano," one cargo itemed at Baltimore, the other at New York. The bags were marked as other Peruvian guano, with the addition of "Guanape," and offered at the price of $50 in gold per ton of 2,240 pounds in bags. The advertisement contained a chemist's analysis, exhibiting 9.382 per cent. of ammonia. As in former years the average of first class Peruvian government guano (Chincha Island) contained 17 per cent. of ammonia, it will be perceived how necessary it is, even in respect to an officially branded Peruvian guano, that agriculturists should fully inform themselves of the character of the article offered them.

LAWS CONCERNING COMMERCIAL MANURES.

The following are the leading points of an "act to prevent fraud in the sale of commercial manures," which has been enacted by the legislature of Maine, taking effect in July, 1869: Commercial manures held for sale in the State shall have affixed to every package of fifty pounds or upward a printed label, specifying the name and place of business of the seller, and the percentage which the manure contains of soluble phosphoric acid and of ammonia. Failure to comply with this provision, or the affixing of a false label, is punishable by fine. Purchasers of commercial manures which bear the label of percentage, &c., may, in an action for debt, recover from the seller at certain fixed rates. The act does not apply to manures prepared exclusively from fish and sold as such, nor to other commercial manures sold at prices not exceeding one cent per pound. Other States have taken action in the same direction.

COMBINATIONS FOR THE PURCHASE OF FERTILIZERS.

On account of the exposure of enormous adulterations of artificial manures and of feeding materials in England, the formation of clubs of buyers is becoming current there for the purpose of buying at wholesale, the fertilizers purchased being subjected to analysis by chemists employed by those associations. In connection with this subject Professor Voelcker relates some striking instances of artifice used to conceal fraudulent manipulation. In one case the venders of a certain description of guano forwarded to him a sample for analysis. After obtaining this, they added to their guano a large proportion of yellow, sandy loam, and sold the mixture at auction under the analysis procured from him. By this contrivance the mixture sold at £7 to £9 per ton, though not worth more than £2 to £3 per ton. Other instances of similar and equally gross deception had come to his knowledge. In another case a manufacturer sent him a cake of pressed indigo seed, inquiring whether it could safely be mixed with feeding cake.

A paper signed by William Little, in behalf of the South Lincoln Association of England, and addressed to the chemists of Great Britain, sets forth the satisfactory results obtained by the combined action of the association in respect to the purchase of artificial manures. The writer alludes to the immense importance which the trade and manufacture of artificial manure are assuming in England, the market being flooded with specific manures for every kind of crop, and remarks that the frauds practiced by dishonest manufacturers in counterfeiting approved artificial manures threaten a serious check to the progress of agriculture. In reference to the advantage in reduction of price obtained through associated action, he states that a few months before the date of his communication he was paying to a very respectable firm £6 10*s.* per ton for a certain manure, a better quality of which he could now obtain at £4 2*s* 6*d* per ton, with the assurance afforded by the agency of the association that any fertilizer purchased will be as represented.

The association purchases only one kind of artificial fertilizer, viz., superphosphate of lime, the members believing that with them the manure derived from stock will, in general, supply every other soil-food that can be profitably employed. Though not denying that "special" fertilizers may be useful in special cases, they are disinclined to use them on account of their high comparative cost, arising from secret and patented processes of manufacture which prevent open competition. It is further urged that in no case should a farmer use an artificial manure when he is entirely ignorant of its composition. This objection does not hold against genuine phosphate manures, the composition of which is well understood, and the manufacture of which is subject to general competition. By proper associated action, such fertilizers can be obtained of tested quality, and at comparatively low rates.

SALT AND LIME.

Professor Johnson recommends the following as an excellent combination for fertilizing purposes:

Mix one bushel of salt with two bushels of dry lime, under cover, and allow the mixture to decompose gradually, thus forming an intimate chemical union of the two materials. For this purpose the mixture should lie at least six weeks before use, or, still better, two or three months, the heap mentioned being turned over occasionally. This salt and lime mixture, when applied at the rate of twenty to thirty bushels per acre, forms an excellent top-dressing for many crops. It acts powerfully on the vegetable matter of soils. Fifty bushels applied to a turnip field have produced as large a crop as twenty loads of barn-yard manure. It is also very destructive to insects and grubs in the soil. Like salt, it attracts moisture from the air, and has been found useful against

drought. Its decomposing power is remarkable; and if three or four bushels of it are mixed with a cord of swamp muck, the latter will soon be reduced to powder. Coarse manure is in a similar manner decomposed and made fine. Sour, wet muck, thus treated and composted with barn-yard manure, constitutes a fertilizer almost as valuable as the unmixed manure of the barn-yard.

HOME-MADE FERTILIZER.

The Boston Journal of Chemistry recommends as a cheap and reliable substitute for commercial fertilizers, such as superphosphates, &c., the following combination, viz:

Take one barrel of pure, raw, finely-ground bones, and one barrel of the best wood-ashes; mix them on a floor, and add gradually three pailfuls of water, mixing thoroughly with the hoe. Use in small quantities in about the same manner as the superphosphates. If the ashes cannot be procured, dissolve twelve pounds of potash in ten gallons of hot water, and with this solution saturate the bone-flour thoroughly; a barrel of dry peat or good loam, without stones, may be added. The mixture should not be sticky, neither too moist nor too dry. In applying it avoid direct contact with the seed; for instance, when applied in the hill, scatter a little earth over it before dropping the seed. A very early visible effect should not be anticipated, but the good results will manifest themselves as the season advances.

THE "DR. VALENTINE GUANO."

For purposes of comparison, the recipe of the "Dr. Valentine guano" is here reproduced, showing the constitution of one ton of this fertilizer. The manufacture should be carried on in a dry place, under cover:

Take twenty bushels of dry peat, three bushels of wood-ashes, and five bushels of bone-dust, and mix them together; then take forty pounds nitrate of soda, twenty pounds of sal ammonia, eleven pounds of carbonate of ammonia, twenty pounds sulphate of soda, ten pounds sulphate of magnesia, and ten pounds common salt; mix these ingredients in sufficient water to dissolve them—say four or five pailfuls. Add this solution to the three articles first named, and mix as in making mortar. When thoroughly intermixed, add three bushels of calcined plaster, which will absorb the superabundant liquid, and bring the composition into a dry condition. Pack so as to exclude air. If occasion requires, garden mold or clean virgin soil may be substituted for the peat.

Dr. Nichols, the well-known Boston chemist, recommends increasing the bone-dust to four or five bushels, and to substitute nitrate of potash for the nitrate of soda, and that the rate of application on ordinary northern soils be from a half ton to a ton per acre. The cost of the ingredients will depend on circumstances of locality, &c., but may be approximately stated at $20 per ton, not including the peat.

MANURIAL VALUE OF FOREST LEAVES AND PEAT.

Dr. Nichols, of the Boston Journal of Chemistry, states, as the result of analysis and practical experiments, that a cord of dry forest leaves, comprising the usual deciduous varieties—maple, beech, oak, &c.—has an actual manurial value of not more than 50 cents, as compared with good stable manure at $8 per cord. His experience inclines him to urge on the farmers of his region the propriety of employing seasoned peat as an absorbent in their stables, rather than to haul peat or muck a great distance for direct use as a fertilizer, either alone or in compost. Used as an absorbent of liquid manure, he finds the seasoned peat to be of great value.

IRRIGATION.

IRRIGATION AND AGRICULTURE IN UTAH.

The Deseret Agricultural and Manufacturing Society reported, in 1868, an expenditure for irrigation in one year of $246,938. Number of acres irrigated, 93,799. The acreage of Utah crops is given as follows: In cereals, 80,518 acres; sorghum, 1,817 acres; root crops, 6,839 acres; cotton, 166 acres; meadows, 29,876 acres; apple orchards, 906 acres;

peach orchards, 1,011 acres; grapes, 75 acres; currants, 195 acres. A canal, in course of construction by a stock company, is to connect Utah Lake and Salt Lake for purposes of irrigation and mill power.

The Salt Lake Basin, Utah, when settled by the Mormons twenty-two years ago, was a waste of sand and sage-bush; but, through irrigation and cultivation, the soil of a large part of the valley has already been made equal in productiveness to the richest lands of more eastern States. Rev. Dr. Prime, of New York, who has recently traversed that region, speaks of passing through thirty-five miles of cultivated fields, presenting the most beautiful crops of wheat, as their staple production, ripening to harvest without a single drop of rain. The straw and grain were so bright that they shone like silver in the sunlight. As exceptional instances he learned that one acre had produced a crop of ninety-three bushels of wheat, and that nine hundred bushels had been grown on ten acres, the result of extreme care in planting, irrigation, manuring, and cultivation. Salt Lake City, which had neither a tree nor a shrub when first settled by the Mormons, is now, by the aid of its system of irrigation, adorned with great numbers of locust and cotton-wood trees, the former raised from the seed, the latter transplanted from the mountain cañons. Every street has its stream of water, and every garden in the town is regularly watered under the direction of commissioners.

SEWAGE.

SEWAGE AT ALDERSHOTT, ENGLAND.

The Aldershott Sewage farm, consisting of about 100 acres, was originally a tract of sand covered with large flints, of irregular level and broken by knolls, on which were small clumps of heather. An analysis of the soil showed 95 per cent. of silica, 3 per cent. of protoxide of iron, and 2 per cent. of vegetable refuse. The knolls having been pared down and the land otherwise prepared by plowing, sewage was turned on from pipes leading from the troop barracks and the cess-pools at South Camp, two miles distant. In three years the tract has been changed from a sandy waste into a flourishing farm. During the last year six luxuriant crops of Italian rye grass were gathered on the farm, the cuttings being made April 11, May 26, June 25, July 22, in August, and in October. The yield of the year averaged from ten to twelve tons per acre. After two years under Italian rye grass, table turnips, swedes, cabbages, and potatoes are sown. The operations of Mr. Blackburn, the lessee, have relieved the English government of a great perplexity as to the satisfactory disposal of the sewage in question, the removal of which had previously cost £1,200 to £1,500 per annum, even then creating so great a nuisance that a chancery injunction was obtained to stop its being turned into the river Blackwater.

PROFIT FROM SEWAGE IRRIGATION.

C. W. Johnson, the well-known English chemist, reports on profits obtained in growing Italian rye grass, in 1868, on thirty acres near Croydon, England, receiving irrigation by sewage, and managed by the Croydon board of health. The land, a cold, stiff clay, being near London, brought a rent of £10 per acre, and was already prepared for, and in actual reception of, sewage irrigation. A large first crop had been gathered by an outgoing tenant in the opening of the season; and the subsequent receipts from sales of grass cut up to date of October 30 were £613 17*s*., the purchaser cutting and carting the grass at his own expense. The estimated total value of the grass crop of the

season was £913 18*s*. As the sewage was self-distributed, only the wages of labor and the rent are included in the current expenses, viz: Wages, £114 18*s*.; rent, (of thirty-six acres, the total area of the farm, including buildings, roads, and non-irrigated portions,) £360; total, £474, 18*s*. The profit of the entire growth of the season was £438 19*s*., being an average of £14 12*s*. 8*d*. per acre of grass. Mr. Johnson remarks that, owing particularly to the necessity of allowing a continuous flow, sewage irrigation is better adapted to grass than to other crops.

LAYING OUT LAND FOR RECEPTION OF SEWAGE.

W. Hope informs English agriculturists that in case of a dead flat, necessitating an artificial fall, and where only horses can be had to move soil, he is willing to contract to properly lay out lands for the reception of sewage, by ridging and furrowing, for £3 per acre in addition to the expenses of ordinary cultivation, which can be brought in to aid the formation of the land. In cases otherwise similar, where the steam-plow is employed on the farm, the cost of preparation for sewage could be greatly diminished. Where there is any slope, even if quite small, and the steam-plow is used in tillage, the farmer need be at no expense beyond that of his ordinary cultivation, and that of striking a furrow on top of the ridge as a carrier for the sewage, which flows by gravitation. The Edinburgh (Scotland) water-meadows are principally laid out on the ridge and furrow system of preparation for sewage. Thirty years ago these meadows were considered worthless, but have been so greatly improved by the use of sewage that portions have been let by auction at an annual rental of £42 per acre. The ridge and furrow system necessitates at the outset a large outlay, often amounting, in England, to £60 or even £80 per acre, varying greatly according to the nature of the soil and the form of its surface.

FARM MANAGEMENT.

AN AMERICAN CATTLE FARM.

J. T. Alexander, of Morgan County, Illinois, the celebrated cattle dealer, migrated from Ohio to Illinois in 1841, with little capital other than health and energy, which have enabled him to attain his present position. Mr. Alexander's "Home Farm" is situated in Morgan County, and consists of about 9,000 acres; is highly improved, and chiefly devoted to grazing. From this farm he sends three to four thousand fat cattle yearly to the New York market. His "Broadlands Farm" is situated in the southeastern part of Champaign County, and has been under the management of C. L. Eaton, who has furnished the information embodied in the present statement. The "Broadlands Farm" is almost square in form, and contains nearly forty-two square miles. It is entirely surrounded by an Osage orange hedge, from one to two years' growth, set on a ridge made by a large ditching-plow, the ridge being fourteen feet wide at the base. There are on the farm about one hundred miles of Osage hedge, and eighty-five miles of board fence. Two hundred acres are covered by ponds, made by embankments across sloughs. During the season of 1869 there have been 5,000 acres in corn, and 1,400 acres in small grain, &c., though the farm is chiefly used for the summer grazing of cattle. Four thousand head of Texas cattle, received March 1, besides some native stock, have been pastured this year for fall shipment to New York. In addition to this stock, there were on the farm twenty breaking teams, of five yoke each; one hundred horses and mules, and five hundred to six hundred hogs, of differ-

ent ages, a mixed breed of Berkshire and Chester White, the former predominating. A blacksmith's and a carpenter's shop are in constant operation during the season, making and repairing implements. One hundred and sixty men are employed and are boarded on the farm. An accurate account shows the cost of board to have averaged 35 cents per day for each man. The cooking is done by men. In this enumeration of force are comprised a superintendent, a general foreman, six foremen, a bookkeeper, a baker, a blacksmith, a carpenter, a butcher, and seven cooks. The farm is divided into seven departments. The headquarters are in the center, with six stations at convenient points on the farm. A cook is located at each of these points, and draws supplies from headquarters.

A NEW HAMPSHIRE FARM.

Levi Bartlett, of Warner, New Hampshire, sends an account of the farm of J. B. Walker, of Concord, New Hampshire. It comprises three hundred acres, arable land, permanent pasture, and woodland. The tillage land includes one hundred and ten acres of intervale, nearly level, and free from obstructions to the plow; also twenty-five acres of low meadow, improved by draining. Six acres, well manured, are annually put in corn, yielding fifty to sixty bushels per acre, worth $1 25 to $1 50 per bushel. The presence of twitch-grass has required a heavy outlay on the corn crop, it being necessary to go over the field three times with cultivator and hand hoe. This crop for 1868 cost in cultivation $50 per acre; yet the net profit was $33 94 per acre, with the promise of larger profits in succeeding crops of hay. One season of corn or oats on a given plot is followed by several years of grass. Oats or other grain following the corn have been found to grow too rank, and to lodge, harvesting being rendered comparatively unprofitable. Mr. Walker grows about six acres of oats yearly, mostly on inverted sod, averaging fifty bushels per acre, worth 75 cents per bushel. They are cradled and threshed by hand, in order to maintain the straw in condition for filling beds, for which purpose it sells readily at $14 per ton. Hay is the most profitable product, and the farm is conducted chiefly with a view to that crop. The grass lands are generally mowed six years in succession, yielding at least two tons of hay per acre annually. The crop amounts to about 140 tons—110 tons English hay, the remainder meadow hay of varying quality. Sixty to 75 tons are sold annually, at an average for the last five years of $20 to $25 per ton. The farm stock consists of two large horses, four large oxen, (colored Devons,) eight cows, and young stock of different sexes and ages, making a total of twenty-seven head. The cows and young stock are chiefly full-blooded Durham. The manure from this stock, with the addition of about $200 worth of stable manure, purchased annually, steadily increases the fertility of the farm. Besides the arable lands already mentioned, the farm contains forty acres of pasture and one hundred acres of valuable timber and woodland.

DAIRY FARMING IN MICHIGAN.

The following abstract of a statement made to the Department by M. L. Frazier, of Hudson, Michigan, presents a noteworthy instance of good farming on a moderate scale in the west. His farm consists of eighty-two acres, of which sixty-two acres are improved, being chiefly devoted to dairy purposes. During the season of 1869 he kept fifteen cows, from the milk of which he manufactured and sold over 5,000 pounds of cheese, for which he received $720; besides 450 pounds of

butter, amounting to $135. The whey and buttermilk were fed to his pigs. Eighty dollars were received for manufacturing cheese for a neighbor, at two cents per pound; 130 bushels of wheat were sold for $189; 200 bushels of apples, $85; pork, $260; and live stock of different kinds, $282; the total sales amounting to $1,751. This was independent of supplies for the family. The farm work was done by Mr. Frazier and his boys, with the exception of some transient labor, for which he paid in work with his mowing-machine. At the close of the season the condition of the farm was quite as good as at the commencement of 1869.

SMALL SUGAR PLANTATIONS IN LOUISIANA.

Sugar culture in the south was formerly supposed to require a large plantation and heavy outlays for working material. "Before the war," says a Louisiana planter, "$50,000 would have been considered a small sum to invest in sugar-houses and machinery; but now there is a great demand for the little western sorghum mill, with all its imperfections, costing perhaps $300 and worked by two small mules. With such machinery I have seen the cultivator of a few acres turning out eighty gallons of syrup daily, worth in New Orleans 80 cents per gallon. The land in my neighborhood, Bayou Oukasha, Parish St. Landry, is a light alluvial loam, black and rich, and can be broken up to any desirable depth with two good mules. One neighbor, a young man from Pennsylvania, but for some years resident in Louisiana, made a remarkable crop last season. He had but 70 acres of cane, from which he made 193 hogsheads of sugar, averaging 1,200 pounds each, and 400 barrels of molasses, with abundance of corn. He employed twelve laborers regularly, besides eighteen or twenty additional hands in getting in the crop. The net profits were $21,000." The narrator adds that the Opelousas prairies are not inferior in richness to those of Illinois, producing cotton, cane, and corn in abundance. Droves of cattle and horses subsist, winter and summer, on the natural grasses. These fine lands, with tolerable improvements, may be bought for five to ten dollars per acre.

ADVANTAGE OF CAPITAL IN FARMING.

In an address before the Framlingham Farmers' Club, near the close of 1869, Mr. Mechi stated that for his farm of 170 acres he paid £23 per acre, and invested nearly as much more in buildings, drainage, roads, clearances, and machinery. These outlays he regarded as constituting his invested capital as landlord, claiming in return, as yearly rent, £2 per acre, or about four and one-half per cent. Further outlay considered as capital invested by him in his capacity of tenant farmer, averaged per acre as follows: December 31, 1868, live stock, £6 10*s.*; farm houses, £1 1*s.*; tillages, manure, &c., £3 15*s.* 6*d.*; implements and machinery, £2 10*s.*; hay, corn, &c., unsold, £2 5*s.*;—total per acre, £16 1*s.* 6*d.*

With this tenant's capital of £16 per acre, he has for several years obtained from the farm an annual surplus of more than £600 available for rent and profit, after paying all expenses. The statement carried out for the 170 acres shows a landlord's capital of about £7,800, giving a rent income of nearly four and one-half per cent.; and a tenant's capital of £2,720, giving a profit of over £260, or nearly ten per cent., after payment of rent and expenses. Mr. Mechi states, however, that his average annual profit as tenant for a course of years has been twelve and one-half per cent. His large outlay for live stock, which he feeds mostly on purchased food, is the key to his frequent and extraordinary crops and large profits; for through this means he is enabled to apply great quantities of rich manure to his deeply cultivated land.

Such a system accounts for his production of forty tons of mangels per acre in 1869, and for his frequent production of forty-eight to sixty-four bushels of wheat per acre. Yet the soil of his farm was naturally poor, needing more outlay to keep it in condition than would be required on better land; and experience had convinced him that he could have done better with a tenant's capital of £20 to £25 per acre. Many farmers in Norfolk and Lincolnshire employ a capital of £20 to £30 per acre advantageously. In respect to the preparation of the soil Mr. Mechi adds:

To farm to the greatest advantage the soil and subsoil to the depth of three feet should be well manured; now we only manure the top five or six inches. Our root and green crops can never be over-manured, for they feed in the deep subsoil, when in a fit condition. Market gardeners understand this well, and around the metropolis they easily grow seventy tons of mangels per acre, and other crops in proportion.

COST OF HEDGES.

A farmer in Mahoning County, Ohio, states that he has had an Osage orange hedge on his farm for eleven years, and that on a neighboring property is one nineteen years old. Of this description of hedge he says:

It grows rapidly, makes a good and ornamental hedge in a short time, and endures our heat and cold, extreme droughts and wet seasons, flourishing almost equally well in all soils, on hill-side or lowland.

He gives the following statement of the first cost of the hedge per 100 rods, calculated for that region at date of February, 1869: Cost of 3,300 good plants, at $4 per 1,000, retail, $13 20; of preparing the ground and setting the plants, $4; total, $17 20. For three to five years after planting, the hedge will require as much labor as would be expended during that time on a row of corn of equal length, after which it will turn stock better than any other kind of fence. It should be trimmed yearly with a common mowing scythe, one man trimming one hundred and fifty to two hundred rods per day.

THE OSAGE ORANGE IN DELAWARE.

In New Castle County, Delaware, Osage orange hedges are in extensive use. An agriculturist of that section says that he has several miles of such hedge on his farm, and that he does not know a farm where it is not used to some extent. He adds that within the four hundred and twenty-four square miles which the county contains, there exist more than one thousand miles of hedge. This hedge is found to be thoroughly strong and tight, and it is believed that for the region in question no other fence equals it. With rails and posts at $12 50 per hundred, one rod of good post and rail fence costs $1. This fence will last about fifteen years, and then need resetting. One rod of first-rate hedge costs about 50 cents. The correspondent says that he would be willing to fill a large contract at that rate. If properly treated such a hedge would last a hundred years. The oldest hedges in his neighborhood are of about twenty years' standing, and are in thoroughly good condition. Some of these hedges divide fields where the land will readily command $200 per acre. The usual dimensions are about five feet in height and four feet in width.

LIVE STOCK.

FAT STEERS.

Geo. Ayrault, of Poughkeepsie, New York, reports to the Department on four steers, seven-eighths short-horn, raised by him and sold near the close of 1869 to Wm. Lalor, of Center Market, New York City, for $3,200;

the age of one of the animals being seven years, and of the others six years. The largest stood about six feet high, with a girth of ten feet; and the weight of the animals was 3,300 pounds, 3,320 pounds, 3,406 pounds, and 3,440 pounds, respectively; their proportions being good, notwithstanding their enormous size. The aggregate gain in weight during the season of 1869 was 1,460 pounds. The net beef weight of the larger pair, after slaughter, was 4,537 pounds, exceeding, it is claimed, that of any other pair of beeves ever fattened. Their average weight at the age of three years was 1,850 pounds. After attaining this age each received daily a peck of corn meal and wheat shorts, or oatmeal, combined, divided into two feeds, and as dessert, a peck of sugar beets twice a day. In summer, until lately, their only feed was grass, supplemented with a little sweet hay. The second winter the daily feed of meal was increased to ten quarts each, given in two feeds. In the summer of 1869 each received one peck of meal per day, given at morning and at night; and in the winter following twelve quarts of meal daily, in three feeds, besides roots. In their course of feeding they have had, in winter, the best of early cut hay from old meadows, and have usually had access to it in the summer. They were not closely confined in winter, usually having the run of a small yard, with access to water, and with sheds under which they could lie protected from the storms, and were tied at feeding time.

It is Mr. Ayrault's opinion that when cattle are fattening, and it is desired to give them all the grain they will eat without clogging, it is important to feed three times a day; and he considers beets, or their equivalent, essential in winter in promoting the growth of grain-fed cattle. He does not advise heavy feeding for beef until animals are well grown, his practice being to maintain his stock in merely a thrifty condition until they reach the age of three years.

A committee of the Farmers' Club, American Institute, reporting on these cattle, state that they find that the only profit arising from the last year's growth of the animals lay in the increased or "fancy" rates obtained on account of magnitude, and that, in Mr. Ayrault's judgment, five years are the age at which fattened cattle will probably give the greatest profit to the feeder.

STOCK-RAISING *vs.* DAIRYING.

It is an agricultural axiom that situation and soil should determine the choice between different branches of farming. In reference to the profits obtained from stock-raising in Champaign County, Illinois, a grazier of that section, doing a large and profitable business, recently said that as a matter of convenience he made the butter and cheese used in his family, and grew wheat sufficient for his house consumption, but that as a matter of pecuniary profit he believed he should gain by paying 50 cents per pound for butter, 25 cents for cheese, and $12 per barrel for flour. The land, labor, and capital required to furnish him with butter, cheese, and flour would feed and handle fifty steers, the profit from which would be sufficient to supply half a dozen families like his own with the articles named.

TRANSPORTATION OF CATTLE.

The Highland Agricultural Society of Scotland recently awarded a gold medal or £10 to George Menzies, of Staffordshire, England, for a report on the conditions which should regulate the carriage of stock by railway and by sea, as well as transit by common road. The report proposes changes in the construction of cattle trucks, or cars, one of which

consists in making the upper half of the sides of the truck to open outward like doors. Troughs are to be erected at suitable heights and at proper distances on side tracks, and are to be filled with water. Supplies of hay are to be furnished at proper stations, by the railway company, and by compulsory regulation a fixed weight is to be given to each animal every six or seven hours, under the superintendence of a railway employé who is to forward a bill of supplies, which the stock owners must discharge.

At the quarterly meeting of the Edinburgh Chamber of Commerce, January 14, 1869, Mr. Reid, of Granton, strongly denounced the cruelties of the current mode of railway transportation of cattle, and pointed out the natural consequences, viz., mechanical injuries, and even death, and always the direct promotion of disease. He cited the declaration of an experienced London salesman, that cattle worth £30 to £40 each are depreciated £5 each during the journey from the north of Scotland to London. The opinion was expressed that the only way to secure proper rules of transportation is for government to enact stringent regulations to that purpose.

SALES OF SHORT-HORNS IN ENGLAND.

The following statement of average prices is made up from records of sales of English short-horns occurring in different localities from April 22 to June 23, 1869: 25 cows and heifers sold at an average price of $469 75; 14 bulls and calves at an average of $175; 23 heifers averaged $351 25; 20 bulls averaged $284 75; 34 cows and heifers averaged $335 50; 18 bulls and calves, $239 75; 48 cows and heifers, $161 75; 14 bulls and calves, $153; average rates per animal of four other herds, for cows and heifers, $195 25, $143, $134 25, $213; and for bulls and calves, $130 50, $210, $85 75, $119 25.

STEAMING FOOD CHEAPLY.

A farmer recommends, from personal experience, the following economical steaming apparatus: A large box, made steam-tight, placed within a larger box, with some non-conducting material, such as saw-dust, packed between, at least twelve inches thick. The food to be cooked being placed in the steam-box, hot water is to be turned in and the apparatus covered tightly with woolen covers in order to confine the heat.

CURE OF PLEURO-PNEUMONIA.

Sir W. Miles writes to the Wincanton Petty Sessions, Somerset County, in England, that after having had the pleuro-pneumonia in his herd for nearly eighteen months, he has arrested its progress by causing the herd to inhale carbolic acid night and morning, which stopped the disease. The acid was mixed with water, and sprinkled with a watering pot on saw-dust, put under the fore feet of the cattle when tied up. Cures are also reported by causing the cattle to inhale the fumes of sulphur.

REMEDY FOR FOOT-ROT.

The following is reported by Australian inspectors of sheep as an efficacious remedy for foot-rot:

> Mix carbolic acid with an adherent and greasy substance, thus forming a plaster which will adhere to the foot of the sheep for two or three days, prevent contact of air, and allow time for production of the desired healing effect. Where this particular method of individual application is not practicable on account of the number of diseased sheep, a trough may be filled with the medicated mixture and the sheep (their

feet having been carefully pared) made to pass through it, when their feet become impregnated with the substance.

ACCLIMATION OF THE YAK.

The report of the French Acclimation Society, read at its thirteenth annual meeting, in 1868, states that the Thibetian yak introduced in some portions of France is likely to prove serviceable. The pure-bred and the half-bred are adapted to mountain regions, are robust, indifferent to variations of season, tractable, and admirable substitutes for mules, besides giving good promise as butchers' meat.

STEAMING FOOD.

Dewey & Stewart, of Oswego, Michigan, commenced steaming food for stock in the fall of 1868. They use an engine of six to eight horse-power in cutting hay, straw, stalks, &c., and in the steaming operation, and have fed 64 head of cattle, 7 horses, and 350 sheep on cooked food, fattening 22 head of cattle and 70 sheep. They have had the straw from 55 acres, hay from 50 acres, and corn-stalks from 18 acres. By the addition of two pounds of bran to the bushel of straw they claim to have obtained a better food material than hay. From careful estimate they judge that they saved one-third in the expense of wintering their stock, which accepted the food with relish, and were kept healthy and thriving.

ADVANTAGES OF COOKING FOOD.

A. W. Knapp, of Bangall, Dutchess County, New York, having cooked food for a stock of twenty-five cows, says:

The results are that my stock improved, the quantity of milk increased about one-quarter, as near as I can estimate it, and I did not use more than three-quarters the amount of hay when cooked that I did when dry. I cooked meal with the hay. I am thoroughly convinced of the great advantages of cooking, and I propose next winter to cook for sixty head.

A LARGE DAIRY FARM.

The following is an abstract of a statement made to the Department by F. Leser & Co., proprietors of the Woodland and Mont Cabanne dairy farm, near St. Louis, Missouri:

The farm is about one mile west of the limits of St. Louis, and contains between 700 and 800 acres, one-half of which is in pasture, the remainder in meadow and arable land. There is an abundance of good water on the farm. The horse stable contains 48 horses. The principal cow stable will accommodate 672 cows, arranged in twenty-four rows, twenty-eight cows to each row; one milker being allotted to each row. The milkers are chiefly Swiss. The building is 400 feet long and 100 feet wide, with a height of 15 feet in the center. Numerous windows in the sides of the building and several ventilators admit light and fresh air, and serve to properly regulate the temperature. The building is very cool and airy in summer, and during the coldest weather the thermometer does not range below fifty degrees. In the south end of the building are the rooms of the men, the store-room, and the office of the foreman. Along the east side extends a plank road 30 feet wide, on which 12 doors open to discharge and receive the cattle. Within the building and between these doors are twenty-four boxes, into which, through openings above, the daily feed of the cows is discharged from wagons driven along the plank road. About four hundred yards from this stable is the milk-house, with a fine spring of water, and with suitable facilities for cooling the milk. Near by is an ice-house, holding about two hundred tons; also machinery for forcing water up to the stables, and facilities for steaming and cleaning the cans.

The number of cows kept on the farm varies from about 640 in the spring to 840 in the fall. There are also a dozen bulls. The cows are turned out daily, except in cold or stormy weather, when they are watered in the stable. During the summer they remain in the stable only from 3 o'clock till 6 o'clock in the morning, and from 3 o'clock till 6 o'clock in the afternoon, for purposes of feeding and milking. It requires less than half an hour to get the cows back each to her own stall. The milking occupies two hours; and soon after it commences the milk is taken, one hundred gallons at a time, to the spring-house, and immediately poured through strainers into tin

buckets, holding each about eight gallons, which are placed up to the brim in the water. This procedure is found essential to removing the animal odor, and to keep the milk sweet. After the milk has stood six hours, the cream collected on the surface is separated. The milk and the cream are taken to customers twice a day. Milk and cream prepared in the manner stated, and packed in ice, have been kept sweet from ten to twelve days in the summer. Large quantities are furnished by this dairy to the Memphis and New Orleans boats, supplies being laid in for the round trip.

The daily feed of a cow during the winter consists of about one-half of a bushel of brewers' grains, six gallons of distillery slop, mixed with two to five pounds of ship stuff, malt sprouts, bran and Indian or cotton-seed meal, and six to ten pounds of good hay, principally Hungarian. The cutting of green rye is commenced about the first of May. During the season of 1869 fifty acres of rye, forty acres of oats, twenty acres of clover, and eighty acres of Indian corn were fed out. The average yield per cow for the month, including the dry stock, (one-quarter of the whole number,) ranges from twenty-eight gallons in November to forty-three gallons in May and June. This unfavorable result is attributed to the small proportion of good milkers among the milch cows brought to market. Of the 686 calves sold during the year 536 were born at the dairy. No calves are reared. Putting the statement of average yield in another form, and adding one-third for dry stock, the daily average per cow actually in milk ranged from five quarts through November to seven and two-thirds quarts in May and June. The total amount of milk obtained per month ranged from 28,000 gallons in the spring to 22,000 gallons in the fall. Cows growing dry in the fall, unless good milkers, are sold to butchers, and are replaced by purchases made from time to time, but with some difficulty, as most of the cows offered, especially in the spring, are very poor, and are often unable to overcome the change of food. These new arrivals require constant attention and careful feeding during the first four or six weeks.

JOHN JOHNSTON'S DAIRY.

The dairy of John Johnston, the veteran agriculturist of Western New York, is composed of grade short-horns, very fat, and giving large quantities of milk. He says that for his use there is "nothing like the Durham." He finds it best to milk his cows three times a day, and obtains from each a pailful at a milking. The cows have only hay and grass winter and summer. But his hay is very superior in quality, the product of skillfully managed grass-land maintained in high condition by thorough drainage, liberal manuring, and careful exclusion of injurious vegetation.

A FIELD FOR DAIRY FARMING.

A correspondent of the St. Louis Journal of Agriculture remarks that while St. Louis imports large quantities of butter and cheese from the east, and while the supply of milk is insufficient for the city demand, selling at forty cents per gallon, often of inferior quality, in that region it requires only two-thirds as much feed to winter stock as is necessary in New England and New York, and that the cost of a given quantity is less. Within forty miles of the city, and extending along the Maramec River, are broad, fertile valleys, well suited for dairy purposes, bordered by rich uplands, from the bases of which flow hundreds of never-failing springs, and through the entire length of this region runs the Pacific railroad, affording the necessary facilities of transportation.

MILK AT MOBILE.

The price of milk at Mobile is stated to be 80 to 90 cents per gallon, the greater part of the hay, bran, shorts, &c., used for feed being obtained from the north.

COTTON-SEED MEAL FOR MILCH COWS.

Leander Morey, of Cumberland, Rhode Island, in a recent statement says that he has seven large and excellent cows coming in at different times in the year. He markets all his milk, selling the year around, and on this account prefers to buy his cows. After purchasing, it takes him a year or more to bring the animal up to her full capacity. In sum-

mer he gives each cow two quarts of cotton-seed meal daily, in addition to pasturage. In winter four quarts of cotton-seed meal and two to four quarts of Indian meal, with English and swale hay. If out of cotton-seed meal one day, his cows shrink one quart each; neither Indian meal nor wheat shorts will bring them up to the full quantity. After again feeding the cotton-seed meal once a day, they regain their usual product. Andrew Belcher feeds about the same number of cows in a similar manner. He was formerly cautious in the use of cotton-seed meal, but now, after buying a cow, he puts her at once on full feed of this and Indian meal. He paid $70 in the spring for a cow which was said to yield twelve quarts daily. This yield was increased to eighteen quarts daily. Neither Mr. Morey nor Mr. Belcher has ever had a case of garget or swelled udder. Two other herds of milch cows, a few miles distant, in Franklin, Massachusetts, are fed liberally on cotton-seed meal, and are healthy and free from garget.

COTTON-SEED MEAL IN EGYPT.

It is stated that in Egypt cotton-seed meal is so highly valued for the production of oil, and of cake for feeding cattle, that it bears a higher price than wheat.

FEEDING CABBAGES AND TURNIPS.

Mr. Birnie, of Springfield, Massachusetts, reports to the State Board of Agriculture that he feeds cabbages and turnips to his cows *after* milking, with good results and with no injurious effect on the taste of the milk, which was used without complaint.

THE CHEESE TRADE IN CHICAGO.

The Chicago Tribune states that at the opening of 1869 there were in that city three firms engaged exclusively in the cheese trade, doing a total annual business of $900,000; and that about 3,000 tons of cheese were sold in the Chicago market during 1868, three-quarters of which came from the State of New York.

HAY AND GRAIN.

IMMEDIATE CURING OF HAY AND GRAIN.

Mr. Mechi, the well known English agriculturist, makes the following report upon a recent invention in England, to which the Society of Arts has awarded a gold medal and fifty guineas:

> The mechanism is very simple and inexpensive. A rapidly revolving fan, driven by horses or by steam power, is attached to the smoke box of a coke furnace, and (a gauze screen intervening) withdraws all the heat which otherwise would be carried up the chimney or shaft and be wasted, and diffuses it among the grass or corn sheaves exposed to its blast. Grass cut and at once brought to the mouth of the hot blast is converted, in eight or ten minutes, into fine green hay of the very best quality, fit for immediate sale or consumption.

PRIZE FOR SYSTEM OF DRYING GRAIN, ETC.

Among the prizes offered by the Royal Agricultural Society of England is a gold medal for the best system for drying grain and hay in wet weather, sufficiently economical for practical purposes.

MAKING HAY BY MACHINERY.

A western agriculturist reports the cost of making 150 tons of hay by the aid of mowing machine, revolving rake, &c., to be $112 83, or about 75 cents per ton. In another case the following estimate is given of the actual cost of cutting, making, and stacking 37 tons of hay taken

from 25 acres of land: Two teams for the day, \$3; two extra horses for the afternoon, \$1 50; two men on mowers for the forenoon, \$2; four men and a boy for the afternoon, \$5; wear and tear of mowing and gathering machines per day \$5—total \$16 50, being at the rate of 45 cents per ton.

COST OF MAKING HAY.

Returns received by the department show that in 1869 the cost of cutting, curing, and stacking hay, per acre, averaged \$4 51 in New England, \$3 76 in the Middle States, \$3 22 in the South, and \$2 93 in the West.

CLOVER IN GEORGIA.

In the early part of 1869 R. L. Bloomfield, of Athens, Georgia, cut two tons of clover to the acre.

PROTECTION OF STANDING GRAIN.

In some parts of Europe, as a protection against the effect of heavy rains, &c., in prostrating grain, portions of the growing crop on the outer lines of the field are tied together.

PROTECTION AGAINST WIRE-WORMS.

For the protection of grain crops against wire-worms Mr. Mechi advises the sowing of six bushels of salt per acre, just as the plants are coming through.

WHEAT ON CORN GROUND.

Joseph Wright, of Waterloo, New York, on land which has been two years in clover, hauls out manure in the winter; spreads and plows in early in the spring, turning the sod to cover the manure, and then as early in May as possible, plants corn. As soon as the corn is well glazed he harvests, plows the land, giving it a thorough pulverization, and sows wheat on or before October 10. He raised 45¼ bushels of wheat per acre on this corn land the past season, while he obtained only 30 bushels from a well managed summer fallow. After the fall sowing of wheat, a seeding of clover and timothy is made in the spring, and two seasons of clover follow. Notwithstanding a dry season his crop of Dent corn gave 80 bushels per acre.

FRUIT.

FRUIT LANDS OF WESTERN MICHIGAN.

H. S. Clubb, of the Grand Haven Herald, Grand Haven, Michigan, makes a report to the Department on the fruit products and fruit lands of western Michigan, from which the following particulars are presented:

The "Michigan fruit region," popularly so called, is now known to extend the whole length of the eastern shore of lake Michigan. The peach belt may be said to vary from five miles to twenty-five miles in width, and its length is about two hundred and twenty-five miles. With an average width of ten miles, the area comprized amounts to two thousand two hundred and fifty square miles. It is estimated that the proportion of this area actually suited by circumstances of elevation, &c., to the successful culture of the peach and the grape, amounts to one-third, or 430,000 acres, of which about 10,000 acres are already planted in peaches, and probably 2,000 acres in grapes; only a small percentage being yet in full bearing condition. Throughout the entire fruit region the rise of real estate has been remarkable, especially in the neighborhood of the principal shipping points and harbors. There are also numerous small piers and second-rate harbors, where fruit is shipped to some extent, and in the vicinity of these points land which formerly was considered valuable only for ties and wood is now salable at \$10 to \$50 an acre, when all the valuable timber is stripped off, and before it

is cleared for cultivation. The increase in the price of real estate has kept even pace with the confidence which each succeeding year inspires in the success of peach culture. The location of Grand Haven being central with regard to north and south, perhaps the increase here may be regarded as a fair average of the whole region. It is greater at St. Joseph, on account of the longer time the business has been in operation there, while the increase north is proportionate to the time since it was discovered to be practicable to grow peaches at Manistee and Grand Traverse.

Planting peaches and grapes for market commenced in the vicinity of Grand Haven and Spring Lake in 1859–'60. At that time only four or five orchards were commenced. They were planted on land which had been stripped of the pine, and was regarded as of very little value, commanding not more than ten or fifteen dollars an acre, notwithstanding the favorable locality. In 1867 one of these orchards, then containing 16 acres planted to fruit, together with 25 acres of scrubby oak land, full of "grubs," sold for $10,000, cash. A portion of another orchard at Ferrysburg sold in 1869 at $500 per acre. The wild land in the vicinity of these orchards now varies in price from $50 to $200 per acre, as shown by actual sales. There is abundance of land, however, equally good for the production of peaches, situated two or three miles from navigation, which can be bought at $5 to $10 per acre. This land could not be sold at any price two or three years ago, and on account of taxes was considered a burden to owners.

The annexed table presents an estimate of the principal fruit products shipped from ports named in 1869:

Shipping ports.	Apples, bushels.	Peaches, baskets.	Pears, baskets.	Plums, baskets.	Cherries, baskets.	Quinces, baskets.	Grapes, pounds.	Blackberries, quarts.	Raspberries, quarts.	Strawberries, quarts.
St. Joseph	34, 503	687, 126	3, 000	400	600	300	27, 000	744, 024	340, 512	103, 872
South Haven	5, 307	19, 271	......	......	......	......	14, 000	....	....	....
Saugatuck	34, 000	24, 000	400	......	......	......	......	....	44, 000	....
Holland	1, 011	7, 914	......	......	......	......	......	45, 000	....	1. 500
Grand Haven	62, 400	6, 819	209	70	17	......	18, 000	....	25, 000	16, 000
Muskegon	750	1, 500	50	20	13	122	5, 000	550, 000	1, 400	1, 200
White River	400	509	15	......	......	24	1, 400	2, 000	7, 000	1, 400
Ludington	200	300	10	......	......	......	500	600	500	500
Pentwater	300	500	15	......	......	......	700	700	500	400
Manistee	1, 000	1, 600	18	......	......	......	2, 000	1, 800	1, 400	1, 600
Northport	250	706	12	......	......	......	600	700	....	500
Grand Traverse	1, 600	1, 400	25	......	......	......	1, 900	1, 500	1, 700	400
Totals	141, 740	751, 630	3, 754	490	630	446	71, 100	1, 346, 324	421, 812	127, 372

The values of shipments are given as follows: Apples, at 80 cents per bushel, $113,392; peaches, at 85 cents per basket, $638,885 50; pears, at $1 per basket, $3,754; plums, at $1 per basket, $490; cherries, at $1 per basket, $630; quinces, at $1 per basket, $446; grapes, at 10 cents per pound, $7,110; blackberries, at 10 cents per quart, $134,632 40; raspberries, at 12 cents per quart, $50,617 44; strawberries, at 10 cents per quart, $12,737 20; 370 bushels of cranberries, at $4 per bushel, $1,480; 146 baskets of tomatoes, at 75 cents, $110 50; 660 barrels of cider, at $4 per barrel, $2,640; total, $966,925 04. These shipments go to Chicago, Milwaukee, Racine, Sheboygan, Kenosha, &c. In calculating the entire fruit crop of the region in question, 25 per cent. may be added to the above stated amounts, in allowance for shipment by rail and teams to the interior, and to eastern markets, and for amounts of local consumption, making the value of the total product about $1,200,000.

FRUIT SHIPMENTS OF SOUTHERN ILLINOIS.

J. B. Calhoun, land commissioner of the Illinois Central railroad, furnishes to the Department a statement of the amounts of fruit, not including apples, received in Chicago during the season of 1869, by special fruit train over that road, from Centralia and all stations south of that point as far as Cairo. This fruit train commenced running May 25, and was suspended June 19, having transported to Chicago during that time 780½ tons of fruit, of which amount seven-eighths were strawberries. The train was again put on August 10, and finally taken off September 15, having during this latter period brought into Chicago 1,740 tons,

net, of which three-fourths were peaches, the remainder pears, tomatoes, &c. The rate of transportation was 90 cents per 100 pounds from Centralia, increasing to $1 per 100 pounds from Cairo and Jonesborough. The points of largest shipment by this train were as follows: Centralia, 510,900 pounds; Richview, 376,000 pounds; Carbondale, 307,000; Makanda, 638,000 pounds; Cobden, 2,102,000 pounds; Jonesborough, 276,900 pounds; Cairo, 300,500 pounds.

The Chicago Tribune reports the following shipments of fruit and vegetables from Cobden in 1869: Pears, 1,330 bushels; peaches, 8,000 bushels; apples, 23,275 bushels; strawberries, 17,774 bushels; gooseberries, cherries, blackberries, and raspberries, 1,000 bushels; grapes, 58,700 pounds; dried fruit, 63,845 pounds; tomatoes, 4,600 bushels; sweet potatoes, 11,860 bushels.

FRUIT IN EASTERN NEW JERSEY.

A statement received by the Department from William S. Sneden, general manager of the New Jersey Southern Railroad Company, shows the following amounts of peaches, grapes, and small fruits, shipped to New York during 1869, from stations from Port Monmouth to Tom's River, representing forty-five miles in length of road: Peaches, 3,500 bushels; grapes, 12,060 pounds; cranberries, 23,997 bushels; huckleberries, 9,290 bushels. There were also shipped to Philadelphia during the same year, from stations representing eighteen miles of this extent of road, peaches, 100 bushels; cranberries, 4,098 bushels.

FRUIT SAFES.

Since the invention of fruit safes the finest peaches produced at Spring Lake, Ottawa County, Michigan, have been shipped to Boston, Massachusetts, where high prices are generally realized. These safes consist of a series of cases resembling type cases, but having each compartment large enough to contain a peach. These cases are stacked in a ventilated chest, enabling the fruit to be transported by rail any desirable distance without injury.

FRUIT GROWING IN WESTERN ILLINOIS.

Mr. Hyde, near Alton, Illinois, has on one hundred acres of his farm 2,000 apple trees, 3,000 pear trees, including 2,300 standards, 1,500 peach trees, 500 cherry trees, 3,000 grape vines, one acre of Lawton blackberries, 600 gooseberry bushes, and 600 currant bushes. At the time of statement the ground was prepared for 1,000 additional peach trees.

PROFIT OF QUINCES.

N. Ohmer, of Dayton, Ohio, informs the Department that he has about two acres in quinces, three-quarters of an acre having been planted ten years, and having borne regular crops for the last six years. In 1868 he gathered from the three-quarters of an acre three hundred bushels of quinces, which were sold at wholesale for $2 50 per bushel. The land is shallow, spaded each year, and twice in the season he sows salt broadcast over the ground, at time of blossom and again when the fruit is about one-third grown, averaging about a quart to each tree at each sowing. Mr. Ohmer's trees are set ten feet apart, which he finds altogether too small a distance, and he recommends fifteen feet, and that the first branches shall be at least three feet from the ground.

FRUIT IN NORTHWESTERN MISSOURI.

The extension of fruit growing in the more newly settled regions of the

west is instanced in a communication to the Department from a correspondent in Holt County, in the extreme northwestern part of Missouri. He states that the crop of apples for 1869 in that county is estimated to exceed 50,000 bushels. Fifteen years ago the product of apples was less than 2,500 bushels. More than 2,000 bushels of pears were raised in 1869, averaging in price, at least, $3 50 per bushel; and large quantities of grapes, cherries, and plums, of the finest quality, have been produced.

FRUIT SHIPMENTS FROM CALIFORNIA.

A correspondent of the Department writing from Chico, California, says:

Without a railroad our choicest fruits command one and a half to three cents per pound, while with a railroad we could obtain six to twelve cents per pound. The railroad will soon be completed to Chico. Shipping fruit east has been a failure thus far. This result is owing entirely to want of knowledge on the subject. Most of the fruit shipped has been picked while green, and being poorly packed, has been lost before it reached the eastern markets. There can be no question that our apricots, cherries, pomegranates, pears, and grapes can be placed in New York in good condition, and command high prices, but the science of picking and packing must first be understood.

APPLES IN WESTERN NEW YORK.

For the season of 1869 the amount of shipments of apples from Orleans County, New York, mostly for Philadelphia, New York, and Boston markets, was 218,911 barrels, averaging in price $2 75 to $2 80 per barrel. Deducting cost of barrels, the estimated net receipts were $496,928. Shipments by canal and railroad from Niagara County, up to about the first of December, amounted to 210,402 barrels, at an average price of $2 90 per barrel, including the barrel. These figures are exclusive of the amounts manufactured into cider and otherwise used in the two counties.

GROWTH OF THE SMALL FRUIT BUSINESS.

The following is given as an instance of the growth of the business in small fruits, and of its capacity of extension in sections where it has hitherto had but a limited existence. E. J. Potter, of Knowlesville, New York, about forty miles from Buffalo, commenced sending black cap raspberries to Buffalo in 1861, forwarding that season 120 bushels. The fruit met with but little demand, and was sold with difficulty, the price realized being $1 50 per bushel, or less than 5 cents a quart. The next year 200 bushels brought 9½ cents per quart. The third year 335 bushels sold for 10¼ cents per quart; and the fourth year 395 bushels brought 13⅓ cents per quart. Since that year prices have fluctuated, but it is believed that crops have given a fair profit on the average, notwithstanding the enormous increase in the amounts of small fruits sold in that city.

SMALL FRUITS IN EASTERN PENNSYLVANIA.

R. S. Darlington reports to the Department the prices of small fruits at West Chester, Pennsylvania, twenty-two miles west of Philadelphia, the rates generally being about the same as in the markets of Philadelphia. During the season of 1869, owing to the overstocked markets, cultivated blackberries sold as low as 3 cents per quart, against 25 to 30 cents per quart in 1868. The following are the average prices per quart of cultivated berries during 1869, taking them together as they came from the vines, those of extra quality paying 8 to 10 cents more per quart: Blackberries, 8 cents; strawberries, 15 cents; black-cap raspberries, 25 cents; orange raspberries, 40 cents; gooseberries, 10 cents;

currants, 25 cents. Of the large fruits, cherries, with stems, brought 18 cents per quart; while apples sold at 10 to 12 cents per half peck, against 40 cents in 1868. Fruit of all kinds sells to better advantage when assorted according to quality. In that section the product of blackberries under thorough cultivation averages, one year with another, 150 to 200 bushels per acre, the average price for a course of years having been 12 to 15 cents per quart.

LATE VERSUS EARLY STRAWBERRIES.

New Jersey experts in strawberry culture state that in that region a change has taken place in respect to raising early strawberries for the large markets. In this branch the South has now the advantage in competition, and northern growers are turning their attention to the late varieties.

THE WILD GOOSE PLUM.

The reputed habitat of this luscious fruit in this country is stated to be the neighborhood of Nashville, Tennessee. So highly prized is it that it has readily brought $12 per bushel in the markets of Nashville, Memphis, and New Orleans. Under proper thinning this plum attains the size of a pullet's egg.

PROFITS OF CHOICE AND COMMON FRUIT.

At a meeting of the Western New York Horticultural Society Dr. Sylvester said that on one occasion a barrel of pears, good and poor mixed together, was sent to New York City, and for several days could not be sold, though offered at a low price. They were then picked over, and in one hour afterward a market basket filled with selections sold for more than had been asked for the whole barrel. Another gentleman said that when living in New York City, in 1868, a friend had sent him some "lady apples" to sell. The apples brought $25 per barrel, and would have brought $30 had they been received earlier.

DRAINAGE FOR FRUIT TREES.

Lewis Stracke, of Warsaw, Illinois, has ten acres of land, one-fourth of which is occupied by his mansion and grounds, the remainder being orchard and vineyard. The whole tract is underdrained with tiles placed at an average distance of forty feet apart, and at the depth of four feet. The diameter of the main pipe is three inches; of the minor drains two inches. The following is an example of the operation of this system of drains: July 25, of the present year, a heavy rain fell, drenching the soil with water to such an extent that on July 28 the main was discharging the estimated quantity of three or four gallons per minute, while the surface of the soil was dry enough to work on the preceding day. Similar land not underdrained would not have been fit for the plow in less than a week. One portion of this tract is devoted to a young and promising orchard of 1,300 standard and dwarf pear trees, of approved varieties. The vineyard contains 2,400 vines; and in addition to underdraining was trenched with the spade, two feet deep, at a cost of nearly $200 per acre.

NEW METHOD OF GRAFTING FRUIT TREES.

Boisselot's method of grafting the vine, by inserting the graft in the fork between two branches, has been successfully applied to the grafting of fruit trees.

M. Sisty, of Lyons, France, states that he has applied it to a great variety of fruit trees, especially to the pear. This method does not

necessitate the cutting back of the branches. It is not very practicable on large trees, but is principally useful for espaliers and dwarfs in small gardens, and can be usefully employed in experimenting with seedlings. Under this method the old fruit can be retained until the quality of the new fruit can be tested.

A VINEYARD AND WINE-MAKING AT SYRACUSE, N. Y.

On a vineyard of ten acres, within the limits of Syracuse, New York, Mr. Henry Ackerman cultivates five varieties of grapes: Isabella, Concord, Clinton, Delaware, and Diana, the Concord and Delaware being in largest proportion. His product of wine in 1868 was 4,300 gallons. He states that an acre of Concord can be made to produce 1,500 gallons of wine; but, under ordinary cultivation, 1,000 gallons are as much as can be reasonably anticipated. Mr. Ackerman markets his wine chiefly in Syracuse and its vicinity, at prices ranging from $2 50 to $3 per gallon. His sales during the first nine months of 1869 amounted to about 3,000 gallons, leaving but little wine on hand older than the product of 1868.

THE LARGEST VINEYARD IN THE WORLD.

It is stated that on the Buena Vista estate, near Sonoma, California, is found the largest vineyard in the world. Eight hundred acres of the estate are suited to the vine, and four hundred and fifty acres are actually devoted to its cultivation. The season begins about the middle of October, and continues nearly to December, and during this period one hundred Chinamen are employed. The product is 126,000 gallons of wine, exclusive of 40,000 bottles champagne.

VINEYARD NEAR WILMINGTON, NORTH CAROLINA.

A vineyard of four hundred acres, one hundred of which are devoted to the Scuppernong and the Mish grape, has been planted near Wilmington, North Carolina.

MARKET GARDENING.

SHIPPING GARDEN VEGETABLES.

The accurate knowledge of the conditions of supply and demand which is involved in profitably growing garden stuff for distant markets is shown by the following item received from a correspondent in Duplin County, North Carolina:

> About fifty acres of garden peas were grown in this county for northern markets. The first peas were shipped April 29; price $8 per barrel; expenses of picking, freight, &c., about $2 25 per barrel. Price rapidly declined to $2 50 per barrel. Most parties engaged lost $25 to $75 per acre.

VEGETABLES AND FRUIT SHIPPED FROM NORFOLK, VIRGINIA.

The following is a statement of fruits and vegetables shipped from Norfolk, Virginia, in the season of 1868: Strawberries, 1,000,000 baskets; potatoes, 50,000 barrels; peas, 40,000 barrels; cucumbers, 20,000 barrels; squashes, 5,000 barrels; beets, 2,000 barrels; tomatoes, 160,000 boxes; radishes, 40,000 bunches; cabbages, 650,000 heads; melons, 150,000. The estimated value of the articles named is $1,043,200, while the shipments of asparagus, turnips, apples, pears, plums, cherries, &c., reached $41,000 more, making a grand total for the season of not less than $1,084,200.

TRUCK FARMING IN NEW JERSEY.

R. N. Leonard, of Monmouth County, New Jersey, was awarded the

first prize by the agricultural society of that county on the products of his farm in 1868. His statement is made on the products of sales from 85 acres, embracing 9 acres of asparagus, 15 acres of early potatoes, 3 acres of grapes, 50 tons of hay and straw, 500 barrels of turnips, 150 barrels of Goodrich and Harrison potatoes, 33 barrels of Dykeman potatoes, $2,049 worth of watermelons, and miscellaneous sales amounting to $222. The total amount of sales was $12,084 84. The expenses for stable manure, guano, and other fertilizers were $2,294; for wages of labor, $1,541 50; freights and commissions, $1,459 67; total, $5,295 17. Profits, $6,789 67, or nearly $80 per acre.

PREMIUM POTATO CROP, QUEEN'S COUNTY, NEW YORK.

The following is an abstract of the statement of E. H. Bogart to the Queen's County (New York) Society, on a premium crop of potatoes grown by him in 1868. The land was planted to corn in 1867, after being dressed with cow manure at the rate of 10 two-horse wagon loads per acre. In 1868 an application of city horse manure was made at the rate of 20 two-horse wagon loads per acre, spread on the ground. April 20 Harrison potatoes, cut to one eye, were planted, being dropped in every third furrow, at a distance of one foot apart in the furrow, the seed rows being nearly three feet apart. Two barrels of seed potatoes were used per acre. The lot contained 2 acres, 1 rood, and 25 rods, and 855 bushels of potatoes were harvested from it October 22, one measured acre yielding 360 bushels. The account with this one acre stands as follows: 360 bushels of potatoes, at an average value of $1 33 per bushel, $478 80. Expenses: manure, $68; seed, $25; interest on land, $5; plowing and planting, $5; hoeing and plowing, $5; team-work and gathering, $10; total, $118; net profits, $360 80.

MARKETING OF PRODUCTS.

MARKET ABUSES AND THEIR REMEDIES.

J. B. Lyman, reporting to the American Institute Farmers' Club from a special committee on markets, stated that in New York City the up-town consumers pay for butter 10 to 15, and often 20 cents per pound more than it sells for at first hands. The best butter-makers near Philadelphia, on the contrary, sell directly to the consumer. In New York a large proportion of the market prices is absorbed by brokers, middlemen, &c., whose profits vary greatly, being sometimes very large. In the article of apples, for instance, thousands of barrels, on arrival in the city, are sold for $2 75 to $3 per barrel to dealers, who repack the apples, after sorting out a few of the smaller ones, and sell them at $5 per barrel. In this handling of produce by market middle-men unjust and illegal practices are often followed. For instance, the middle-man culls a lot of rhubarb, sells the choice at 20 cents and 24 cents per package, and the remainder at 16 cents, making returns to the farmer at the rate of 16 cents for the whole. It is generally the case that the farmer gets no more for a choice article than for second-rate produce, the middle-man pocketing the difference and saying nothing. On the other hand there are farmers who indulge in dishonest practices; others consign to dealers who do not make a specialty of the article shipped. In view of the trickery and unjust combinations too often observed in the New York markets, the committee recommends: Thoroughly honest packing on the part of the producer; that the farmer be careful to ship to reliable commission firms who deal specially in the articles to be disposed of; and that farmers in every village form clubs for mutual pro-

tection, sending their most vigilant and capable members to the city from time to time for information.

ASSOCIATION OF MILK PRODUCERS.

The annual meeting of the Milk Producers' Association of Massachusetts and New Hampshire, organized for the protection of milk producers, and the regulation of the milk business generally, was held in Boston on the 7th of December, 1869. An encouraging degree of success was reported and a proposition made that all farm products be included in the scope of the society's protection. The directors report that from the most reliable information they are satisfied that an amount not less than twenty-five per centum of the entire quantity of milk sold in Boston is manufactured by the dealers by adulteration.

MARKET VALUE OF AN ESTABLISHED NAME.

A fruit cultivator in Western New York lately sent several half-barrels of selected Bartlett pears to his commission agent in New York City, and at the same time similar packages containing very fine selected specimens of Doyenné Boussock, which would have been judged by some persons decidedly superior to the Bartletts. Notwithstanding the overstocked condition of the markets, the selected Bartletts sold for $6 to $9 per half-barrel, while the Doyenné Boussock pears would not bring over $3 50.

MISCELLANEOUS.

PRICES OF POTATOES.

Market variations consequent upon demand and supply, especially at certain seasons of the year, are illustrated by the following table of wholsale prices of potatoes in the New York market on the stated days of 1869:

	Per barrel.		Per barrel.
January 14,	$1 50 to $3 50	July 13,	$2 00 to $7 00
February 15,	1 50 to 3 50	August 14,	88 to 1 50
March 15,	1 50 to 3 00	September 13,	1 00 to 1 75
April 14,	1 50 to 3 00	October 13,	1 25 to 2 25
May 14,	1 00 to 2 25	November 15,	1 25 to 2 00
June 14, old	1 00 to 1 50		
June 14, new	4 00 to 10 00		

The differences between the proceeds of the best and of inferior varieties are instanced by the fact that, in the same market, August 22, while prices of inferior potatoes ran as low as 75 cents per barrel, the Peach-blows and the Mercer brought $1 75 per barrel.

RECLAIMING WASTE LAND.

Dr. J. R. Nichols, of Massachusetts, states that he had one and a half acre of meadow which had lain for many years worthless, being full of hassocks, rushes, wire-grass, stumps, and rocks. In September, 1868, he put three men upon it with a heavy yoke of oxen and before the end of the month it was drained, the soil pulverized and mellowed, the surface made as level as that of a prairie, and grass seed sown. In July, 1869, it gave a larger cutting of timothy, in proportion to area, than was obtained on any other part of the farm. This first crop paid all the expenses of reclaiming.

"The Heath" district, in the neighborhood of the city of Lincoln, England, was formerly a wilderness so desolate that a light-house was erected in its midst for the guidance of travelers crossing it. Much of

29

it was covered by a light, barren sand, and in places scarce any vegetation was to be found. On this district or plain are now large farms, producing fine sheep and growing immense crops of grain. This great change was initiated by keeping sheep and using artificial manures in growing such crops as were suitable for their food. Through constant treading and the yearly application of concentrated manure the soil gradually acquired consistency, reaching at length its present highly productive condition.

RESULTS OF DRAINAGE.

At the New York State Fair, September, 1869, Mr. Boardman, of Ontario County, stated that he had drained twelve acres of land which previously, except on knolls, would not produce wheat. His drains were laid two and a half feet deep and thirty-six feet apart, at a cost of $30 per acre. He then plowed deep, two men following the plow with crow-bars in order to remove stones. His crop this year was forty bushels of Diehl wheat per acre.

AGRICULTURAL EDUCATION IN GERMANY.

J. M. Gregory, regent of the Illinois Industrial University, writing from Paris, in August, 1869, states that in a personal interview he inquired of Baron Liebig if agricultural education in Germany had been successful thus far, taking the results as a whole. The reply was that the success had been very great. In Hesse, for instance, the value of the land had increased 300 per cent. under the improved methods of culture introduced by the diffusion of agricultural science. This increase has not come through enlargement of population, but by actual improvement in the productiveness of the soil.

PAYING FOR THE FARM.

Near the close of 1867, a farm of 160 acres was purchased in Plumas County, California, at the cost of $3,700. The crops raised in 1868 were 1,500 hundred-weight of wheat, 2,000 hundred-weight of barley, 1,000 sacks of potatoes, 140 hundred-weight of flax-seed, and $120 worth of mustard-seed, gleaned from wheat. The barley sold for $2 per hundred-weight, realizing enough to pay for the farm. The flax-seed sold for $4 per hundred-weight. The entire products of the farm sold for $7,500, or twice the cost of the farm.

GROWTH OF SOUTHERN CALIFORNIA.

A. S. Taylor, of Santa Barbara, California, writing in the early part of the present year, states that since the spring of 1867 the coast country of California between San Diego and Monterey has experienced a great change from its former dullness and apathy, and the population, from all reports, has been more than doubled. In the spring of that year a large immigration from the northern section of the State, and from the Atlantic States, consisting of steady farmers and mechanics, with their families, teams, and tame stock, came in and bought land in large quantities, and gave an entirely new life to this long-neglected portion of the republic, which, within its own confines, covers as many square miles as the entire State of Pennsylvania. Within this short time as many as 50,000 new settlers have established themselves in the country mentioned.

THE CASTOR BEAN IN CALIFORNIA.

The castor bean is becoming an important product in Perry County,

California. One prominent dealer received at his warehouse in one day 1,000 bushels, paying $8 18 per bushel.

MOWING WITH A HOE.

A correspondent, writing from Marion County, Florida, says:

We had thunder and lightning every day in July. On the 30th of July planted one hundred and fifty orange trees, cut down to within three feet of the root. The period referred to is, strange as it may seem to people North, the time for planting all kinds of trees. Anything will germinate here in the rainy season. It is astonishing how the grass grows. I mow every day between the showers a variety of fine grasses to cure for the winter use of my cattle. They mow grass here with a hoe. It's a fact. A well-known physician told me the other day that he believed there was not a scythe in the city except mine. Those who don't mow with the hoe do so with the reaping hook. But I see some signs of improvement.

CANNING SWEET CORN.

It is stated that 2,400,000 cans of sweet corn have been put up in Maine the past season.

SALT MINES IN LOUISIANA.

The recently opened salt deposits on Petite Anse Island, in Southern Louisiana, are near the Gulf coast, and about one hundred and sixty miles west of the South-west Pass of the Mississippi. In the fall of 1869, under the direction of the Louisiana Rock Salt Company of New Orleans, the miners were taking out forty to fifty tons of salt per day, and a steamer built for the trade was making three trips per week from the mines, bringing each trip a cargo of one hundred tons. It is claimed that authoritative chemical analysis, and the practical experience of packers, prove the Petite Anse salt to be at least equal in value to Turk's Island and Liverpool salt.

SWEET POTATOES IN BULK.

A sweet potato grower in Southern Illinois states that sweet potatoes will keep in bulk. He has kept seven hundred bushels in one pile. The potatoes should be dug before the vines are injured by frost, sunned until dry, and then placed in a cellar on a clay floor, putting fine hay or flax straw between the potatoes and the wall, and covering with the same material. The deeper and larger the pile the better. The hay or straw should be covered with clay, a thickness of one or two inches being sufficient for the climate of that region. At the top should be left one or more air-holes, according to the size of the pile, for the escape of steam. In damp warm weather open a window or door in the day-time.

PROCESSES FOR PRESERVATION OF MEAT.

The Mark Lane Express states that of more than one hundred processes for the preservation of food which have been patented during the present century, twenty-six are for preservation by drying, thirty-one by excluding atmospheric air, nine by covering with an impervious substance, such as fat, gelatine, paraffine, or collodion, and seven by injecting various salts. It is stated that a resident of Sydney, Australia, has invented a process for freezing meat in large quantities, by which three hundred tons of meat can be shipped at once; the cost of freezing and freight from Australia to England being only one penny per pound.

FISH CULTURE.

E. S. Woodford, of West Winsted, Connecticut, writes to the Department that, in view of the very numerous ponds and lakelets in New

England which are now almost worthless as food producers, inhabited only by the voracious pickerel, he has been led to consider what fish can be introduced into the waters to make them yield a large amount of delicious and wholesome food. From his experiments for the last seven years he concludes that the black bass is the only good fish which can be largely propagated where the pickerel abounds. Seth Green, the noted pisciculturist, says:

Expend one-thousandth part of the sum spent in tilling the land in tilling the water, and fish may be sold in our markets at two cents per pound. I have contracted to furnish our commissioners with one thousand or more bass for the next season. The selectmen, in towns where they wish ponds stocked, make application to the commissioners, who order the necessary number to be placed in them. Fifty to two hundred fish that will spawn the next season will, in a few years, produce an incredible number, and ponds that have heretofore produced only a scanty supply of pickerel will furnish a large amount of delicious and wholesome food.

PROGRESS OF INDUSTRIAL EDUCATION.

CONNECTICUT.

The report of the Sheffield Scientific School, a branch of Yale College, to which the proceeds of the land grant of this State were appropriated, so far as it relates to the Agricultural Department, is identical with that noticed in our last annual report. In this school agriculture occupies only a subordinate position. Its chief aims are to impart a scientific education, to train "young men in the modern scientific professions, chemistry, engineering, &c., and will seek for a distinctive character, not so much by offering peculiar attractions to farmers as a class, or to mechanics as a class, as by inviting students who wish to become scholars in science, well trained in the higher departments of investigation, able to stand unabashed by the side of scholars in letters." A shorter course, under the direction of Professors Brewer and Johnson, is given during the fall and winter terms for the benefit of those who do not wish to pursue the entire course. These lectures embrace agricultural chemistry, practical agriculture, stock-breeding, and agricultural zoölogy.

ILLINOIS.

The Illinois Industrial University was opened for the reception of students in March, 1868. The main university building is of brick, one hundred and twenty-five feet in length, and five stories in height. It has public rooms, such as lecture and recitation rooms, and rooms for libraries and laboratories, for the accommodation of four hundred students. The farm on which the buildings are situated consists of one thousand acres. Forty acres of this splendid domain are set apart for gardens, nurseries, and an arboretum. The remainder is to be used for experimental and stock farms. The manual labor system is to be thoroughly tried. Students go out in "labor classes" under the supervision of some officer of the institution, and work from one to two hours daily except on Saturday and Sunday. While this labor is intended to be educational, it is found to be promotive of the health and vigor of the students, and to facilitate, rather than hinder, study. The trustees express the hope that they may render the labor system one of the most popular features of the university with the public, as well as with the students themselves. The course of study of this institution was given in detail in our annual report for 1867.

IOWA.

The first regular year of the Iowa State Agricultural College was opened March 17, 1869. On that day the college building was formally dedicated and the officers of the institution inaugurated as follows: A. S. Welch, M. A., president; George W. Jones, M. A., professor of mathematics; Norton S. Townshend, M. D., professor of practical agriculture; Albert E. Foote, M. D., assistant professor of chemistry; O. H. St. John, B. S., assistant professor of geology; Mrs. Catherine S. Potter, matron; Miss Augusta Mathews, teacher of piano music; Miss Lillie Beaumont, teacher of the French and German languages; Hugh M. Thomson, superintendent of the farm.

Of the students enrolled in the freshmen class during the first term there were 77 young men and 16 young ladies. The number admitted to the preparatory department was young men, 59; young ladies, 21; whole number, 173; attendance during the second term, 168. Table attendance of different students during the year, 192, representing fifty-five counties of the State. The following is the course of study:

FIRST YEAR—*First term.*—Algebra, rhetoric, book-keeping. *Second term.*—Geometry, physiology, and hygiene, English language and literature.

SECOND YEAR—*First term.*—Trigonometry, mensuration, and surveying, general chemistry, botany, and vegetable physiology. *Second term.*—Mechanics, analytical chemistry, analytical geometry, zoölogy, practical agriculture, descriptive geometry.

THIRD YEAR—*First term.*—Analysis of soil, entomology, practical agriculture, botany, horticulture, forestry, mechanics of engineering, shades, shadows, and perspective, differential and integral calculus. *Second term.*—Chemical physics, geology and mineralogy, comparative anatomy and physiology, practical agriculture, mechanics of engineering, machine drawing.

FOURTH YEAR—*First term.*—Agricultural chemistry, landscape gardening, rural architecture, history and principles of architecture, architectural drawing, carpentry and masonry, political economy, and logic. *Second term.*—Mental philosophy, constitutional law, veterinary science and art, civil engineering.

For the first year the course of study is the same for both sexes. After this the course for ladies consists of studies adapted to meet their special wants. Ladies may, however, at their option, pursue any course of study taught in the college.

All members of the college devote the afternoon to manual labor, spending two or three hours per day, according to the season, the weather, and the wants of the farm and workshop. The rate of payment varies from three to ten cents per hour, according to the value of the service. The young ladies engage by rotation in all the different processes of the housekeeper's art. The amount disbursed for students' labor in 1869 was $4,597 65.

The expenses of students are reduced to the lowest figures possible. Board is furnished and washing done at actual cost. Students make a small deposit once a month for board, and settle all accounts at the end of the term. Incidental expenses are limited to the injury actually done to the furniture and rooms. Books are supplied by the institution at wholesale price. For the year 1869 the price of board was $2 75 per week, and 50 cents a dozen for washing.

Each representative district may send one student for every representative elected in such district to the popular branch of the legislature.

Application for a certificate of admission to the college must be made to the superintendent of schools in the county in which the representative resides. The superintendent examines all candidates for admission, and decides between them by lot.

Under the organization of the institution, as contemplated by the board of trustees, additional professors will be appointed, one each, in the following departments: Human physiology, hygiene and physical culture, English language and literature, political economy and constitutional law, logic and psychology, botany and horticulture, zoölogy and entomology, chemistry, geology and mineralogy, physics and mechanics, descriptive geometry and architecture, civil engineering, science and art of teaching, military engineering, French and German languages, vocal and instrumental music, and also an instructor in drawing, and a preceptress who will also instruct in domestic economy and household duties. The full catalogue contains seventeen professors, who will be needed when all the departments are in complete operation.

Besides the regular working force the trustees have adopted the views of the committee on organization in appointing men eminent in science and the arts to deliver courses of lectures before the students and such citizens as desire to attend. Six of these non-resident professorships have already been filled by the selection of distinguished gentlemen from different institutions of the country.

KANSAS.

The wise policy of the legislature of this State in locating the land accruing under the congressional grant promises to insure an endowment for the State Agricultural College of over $550,000. Of the land received and located by the State 43,000 acres have been disposed of for $176,300, or an average of $4 10 per acre; while the remainder of the grant is held at rates which will realize about $380,000. When the whole amount is disposed of, the annual income of the college will be nearly $40,000. The interest of the fund already accrued is sufficient to meet current expenses for payment of the faculty, &c., and no further appropriations by the legislature will be required.

The college is located in the Kansas Valley, near Manhattan, Riley County, easy of access by railroad and otherwise. The college building is of beautiful gray limestone, sixty feet in length by forty-four in width, three stories high, surmounted by a beautiful cupola. The third story is occupied as a chapel, capable of seating four hundred persons. On the second floor are four rooms, a music room and three recitation rooms, with hall; on the lower floor are the hall, the president's office, library, school-room, and recitation room. The boarding-house is a stone building capable of accommodating sixty students.

During the year there have been 173 students, of whom 97 were gentlemen and 76 ladies, females being admitted to equal privileges with males in the studies of the institution; and the board of regents testify that the ladies have proved themselves every way worthy and capable of competing successfully in them. Of the eight members of the faculty two are females, one professor of the German language and English literature, the other teacher of instrumental music.

The courses of study consist of a classical course, agricultural and scientific course, military science and tactics, mechanic arts and engineering, academic and preparatory course, commercial and mercantile course, and a manual course. The agricultural and scientific course is as follows:

FIRST YEAR—*First term.*—Soils in their relation to vegetation, water,

atmosphere, and also in their relation to vegetable products; recitations; lectures and field practice on the farm; algebra and modern history. *Second term.*—Subsoil plowing, tillage, draining and fertilizers; algebra; natural philosophy, with lectures. *Third term.*—Botany, (Gray's,) zoölogy, (Agassiz's,) meteorology, (Loomis's,) geometry, (Robinson's,) botanical lectures, excursions and field instruction.

SECOND YEAR—*First term.*—Structure and physiology of plants; buildings; fall crops and use of farm; machinery and best farm implements; preservation of seeds; recitations, lectures and field instructions; geometry, (Robinson's,) logic, (Coppée's.) *Second term.*—Physiology and care of domestic animals; diseases of cattle and horses; propagation and cultivation of forest trees adapted to hedges and their cultivation; recitations, lectures, trigonometry, (Robinson's,) logic, (Coppée's.) *Third term.*—Horticulture and kitchen gardening; propagation and training of fruit trees, vines, especially the grape, small fruits and vegetables; grafting; recitations and lectures; surveying and engineering.

THIRD YEAR—*First term.*—The staple grains, forage, root and fiber crops of the Northern and Middle States, with their varieties and soils adapted to them; insects injurious to vegetation; origin and natural history of domestic animals; conic sections, (Robinson's,) mental philosophy, (Haven's,) chemistry. *Second term.*—Raising and care of domestic animals, characteristics and adaptation of breeds, cattle for beef, draught and dairy, horses, sheep, swine, pasturing, soiling, and stall feeding; agricultural botany, destruction of weeds and noxious plants; farm book-keeping; chemistry, with lectures; physiology, (Hitchcock's,) "how plants grow," (Johnson's.) *Third term.*—History of agriculture and sketches of husbandry in foreign lands; adaptation of farming to soil, climate, market, and other natural and economical conditions; systems of farming, stock, sheep, grain, and mixed farming; geology, (Dana's,) moral philosophy, (Haven's,) political economy, (A. Walker's.)

Agricultural, zoölogical, botanical, and geological excursions during the fall and spring terms of the second and third year will be conducted under the guidance of the professor of agriculture and the professor of natural sciences, and are intended to be thoroughly practical in their character.

Daily and weekly exercises in music, calisthenics, composition, and general reading; the same each year as in the classical course.

Tuition is free in all the departments except instrumental music. A contingent fee of $3 per term is charged for fuel, light, &c. Board is furnished at $3 75 per week.

The college has thus far furnished ninety-five teachers to the schools of the State.

KENTUCKY.

In our annual report for 1867, an account was given of the establishment of the Industrial College of Kentucky, as a department of the Kentucky University, at Lexington, now in successful operation and which promises to rank with the first institutions of learning in the country. The endowment of the university amounts to over $400,000, and its real estate to about $300,000.

The university embraces a college of science, literature, and art; an agricultural and mechanical college; a college of the Bible; a normal college; a college of law; and a college of medicine; the whole being under the general superintendence of the regent, J. B. Bowman, who represents the curators and donors, with a separate faculty for each college, while the course of study and instruction in each college is full

and complete. The four which are first named are so associated that a student regularly matriculated in any one of them may have the benefit of instruction in the others without additional charge for tuition. The agricultural and mechanical college embraces a thorough course of instruction in military tactics.

The faculty of the agricultural and mechanical college embraces Henry H. White, A. M., presiding officer; Robert Peter, A. M., M. D., James K. Patterson, A. M., H. James Clark, A. M., W. G. Strange, A. M., E. Denning Luxton, J. F. Eyraud, B. L., C. E.; superintendent of farm, John A. Dean; superintendent of mechanical department, David Calder; superintendent horticultural department, Joseph Walter.

I. *School of English Language and Literature.*

FRESHMAN CLASS—*First term.*—Fowler's English grammar; Klipstein's Anglo-Saxon grammar and Analecta Anglo-Saxonica; lectures on the science of language; exercise in English composition and elocution. *Second term.*—The same, with the addition of the Anglo-Saxon version of the Holy Gospels.

SOPHOMORE CLASS—*First term.*—Blair's Lectures on Rhetoric and Belles-Lettres; essays, declamations, and debates. *Second term.*—Kames's Elements of Criticism; Chambers's English Literature; essays, declamations, and debates.

JUNIOR CLASS—*First term.*—Chambers's English Literature; Whately's Logic; essays, declamations, and logical disputations. *Second term.*—The same, with original declamations.

SENIOR CLASS—*First term.*—Lectures on English literature; readings in English literature, with critiques; theses, original orations, disputations, and exercises in extemporaneous speaking. *Second term.*—The same, with the addition of Sampson's Elements of Art Criticism, with lectures and illustrations.

II. *School of Mathematics.*

FRESHMAN CLASS—*First term.*—Towne's Algebra. *Second term.*—Davies's Lègendre's Geometry, Books I, II, III, IV, V, VI.

SOPHOMORE CLASS—*First term.*—Davies's Lègendre's Geometry, Books VII, VIII, IX; plain trigonometry and mensuration. *Second term.*—Loomis's Surveying and Navigation; Loomis's Analytical Geometry.

JUNIOR CLASS—*First term.*—Loomis's Calculus. *Second term.*—Snell's Olmsted's Mechanics.

SENIOR CLASS—*First term.*—Davies's Spherical Trigonometry; Snell's Olmsted's Astronomy begun. *Second term.*—Astronomy completed.

III. *School of Chemistry.*

JUNIOR CLASS—*First term.*—Elementary chemistry; daily lectures, with experiments. *Second term.*—Lectures on chemistry, with experiments.

SENIOR CLASS—*During the session.*—Experimental and applied chemistry and chemical physics; five lectures per week, illustrated with experiments, models, &c. The application of the science to agriculture, the arts, and manufactures is indicated, and the art of testing in general, and the detection of poisons, considered; organic chemistry is discussed during the latter part of the course, and instructions given in the chemistry of vegetable and animal physiology; instructions in practical chemistry, including the chemistry of the soil, as soon as students are sufficiently prepared. *Text-books.*—Youmans's new Class-Book of

Chemistry; Fownes's Chemistry for Students; Graham's Elements of Chemistry.

IV. *School of Natural Philosophy.*

In this school there are two classes. In the junior class the object is to give the student a comprehensive general view of this department of physics, and to familiarize him with its methods of investigation without the introduction of mathematical symbols. In the senior class the same subjects will be studied, but with greater exactness, and with the use of mathematical demonstrations and formulæ. In both classes instruction is given by lectures and text-books, and the subjects illustrated by experiments.

V. *School of Natural History.*

To enter this school, students must have attended at least one course of lectures upon chemistry, and sustained a satisfactory examination in the same.

SOPHOMORE CLASS—*First term.*—Structural and physiological botany, or the anatomy and mode of life of plants, especially in reference to their cultivation and propagation. *Second term.*—Systematic botany, or the study of the species, varieties, races, &c., of plants, and the classification according to affinities.

JUNIOR CLASS—*First term.*—Human anatomy; structural zoölogy, or the anatomy of the brute creation, domestic animals, &c. *Second term.*—Human physiology, or the laws of the human body and the preservation of its health, both physical and mental; collecting and preserving specimens, &c.

SENIOR CLASS—*First term.*—Geology, or the history of the structure of the earth, and the phenomena of mines, metals, ores, stone, mineral springs, &c. *Second term.*—Paleontology, or the history of fossil animals and plants, and their agency in the formation of coal beds, coal oil, limestone, &c.

VI. *School of History.*

JUNIOR CLASS—*First term.*—Smith's History of Greece, Liddell's His- of Rome; lectures. *Second term.*—The Student's Gibbon, Political Economy; lectures.

SENIOR CLASS—*First term.*—The Student's History of France, the Student's Home; lectures. *Second term.*—Willson's History of the United States, Constitution of the United States.

VII. *School of Mental and Moral Philosophy.*

JUNIOR CLASS—*First term.*—Mental philosophy begun. *Second term.*—Mental philosophy completed.

SENIOR CLASS—*First term.*—Moral philosophy. *Second term.*—Evidences of Christianity.

In this school instruction is given chiefly by lectures; but the following text-books are used: Haven's Mental Philosophy, Hamilton's Metaphysics, Wayland's Moral Science, and Milligan on Reason and Revelation.

VIII. *School of Modern Languages.*

JUNIOR CLASS—*First term.*—German: Otto's Grammar, Adler's Reader. French: Fasquelle's Grammar, Telemaque. Italian: Cuore's Grammar, Foresti's Reader. Spanish: Schele de Vere's Grammar, Velasquez's Reader. *Second term.*—German: Otto's Grammar, Adler's Reader, Schiller's Maid of Orleans. French: Fasquelle's Grammar, Telemaque, Vol-

taire's Charles XII. Italian: Cuore's Grammar, Foresti's Reader, Tasso. Spanish: De Vere's Grammar, Velasquez's Reader, Don Quixote.

SENIOR CLASS—*First term.*—German: Schiller's Mary Stuart and William Tell, composition and conversation in German. French: Corinne, Racine, composition and conversation in French. Italian: Tasso, Goldoni. Spanish: Don Quixote. *Second Term.*—German: Goethe's Iphigenia and Reineke Fuchs, Lessing's Minna Von Barnheim. French: Moliere, Voltaire. Italian: Dante. Spanish: Calderon.

IX. *School of Civil Engineering and Mining.*

In this school will be taught geometrical and topographical drawing, tinting, shading, and lettering; descriptive geometry, linear perspective, shades and shadows, practical astronomy, road engineering, the use of engineering instruments, leveling, architectural drawing; geology of mining districts; metallurgy; mining engineering; construction of furnaces; determination; mineralogy, and history of mining operations.

X. *School of Fine Arts.*

Music, drawing, painting, and landscape gardening will be taught in this school.

XI. *School of Military Tactics.*

The course will comprise practical and theoretical instructions in the tactics of arms, military discipline, including the duties of guards, sentinels, &c., in accordance with the tactics and regulations prescribed for the United States Army.

The act of the State legislature establishing the college as a branch of the university required that the authorities of the latter should raise at least $100,000 for the purchase of an experimental and model farm, and the erection of the buildings necessary for the various uses of the institution. Through the energy of the president, J. B. Bowman, and the liberality of the citizens of Lexington, the amount was secured, and "Ashland," the home of Henry Clay, and the "Woodlands," an adjoining estate, were purchased. The whole tract contains four hundred and thirty-three acres of first-rate land, with fine improvements, and will be the site of the agricultural and other colleges.

The legislature also provided that each representative district in the State shall be entitled to send to the college three students, free of charge for tuition, for each member the district is entitled to send to the general assembly, the students to be selected by a majority of the justices of the peace in the several districts.

All students of the Agricultural and Mechanical College, except such as may be exempted on account of actual physical disability, are required to spend a portion of their time in active labor, either in the agricultural, horticultural, or mechanical department. Students who wish to defray a portion of their expenses can labor four hours upon the farm or five hours in the shops, six days in the week, for which they will receive five to ten cents per hour. All other students are required to work two hours per day, except on wet days, in the horticultural department, without compensation.

The Ashland estate is divided into plots of pasture and tillable lands for the handling of various breeds of stock and for the culture and rotation of crops, and in this department students have ample opportunity, while defraying the expenses of their education, to apply practically the principles of sciences acquired in the class room.

The horticultural department embraces the ornamental and experi-

mental grounds at Ashland, and Woodlands, including gardens, orchards, vineyards, and arboreta, and students receive thorough instruction in horticulture and landscape gardening, and ample facilities are afforded for the practical application of the principles of botany and vegetable physiology, and for a thorough knowledge of the art of grafting, budding and planting, and the general care and culture of all kinds of trees, shrubs, and flowers.

For the mechanical department large buildings for shops of various kinds have been erected, and fitted up with the most approved machinery, for the manufacture of all kinds of agricultural and mechanical implements, including reapers and mowers, cultivators, plows, wagons, &c. In the shops skilled artisans are employed, and practical instructions are given, under which young men have the opportunity of learning a good trade while defraying a large portion of the expenses of their education.

The regent in his annual report states that "the industrial department has succeeded far better than during any previous year, and the wisdom of its plan of organization has been verified by the experience of the past. About one hundred young men have joined the four or the five-hour division during the session, and received compensation for their labor at wages varying from five to ten cents per hour, according to their skill and industry. Many of them have made eight to ten dollars per month, and some much more, an amount sufficient to pay their board under the club system. * * * A large majority of the students voluntarily adopt the two-hour system of labor, which is without compensation, except so far as it is made educational."

The regent expresses entire confidence in the success of the system.

Of the 757 students enrolled in the various departments of the university during the year, 283 were in the Agricultural and Mechanical College; about 300 students received free tuition. Tuition in the Agricultural and Mechanical College to other than State students is $30 per session of nine months, janitor's fee $5, room fee $5; all fees are required in advance. Tuition coupons, admitting students into the college for the whole collegiate year, can be purchased for $10, so that the entire fee of a student in this department need not exceed $20 per annum. Students occupying dormitories set apart for that purpose can, by adopting the club system, board themselves at prices ranging from $1 50 to $2 per week, under which system the expenses of a student need not exceed $100 for the entire session, and students can defray the greater portion of this amount by labor on the farm or in the workshops.

MAINE.

The "State College of Agriculture and the Mechanic Arts" of Maine is located at Orono, near Bangor, in a central part of the State. A farm of suitable land consisting of 375 acres was given to it by the town. While the regular course of instruction embraces a period of four years, a select course is to be organized for the benefit of those who desire to pursue one or more branches of study, such as chemistry and botany. The practical element of this course will give it a special value. In the regular course, the greater part of one year will be devoted to botany and horticulture. This course will embrace "a thorough drill in botanical analysis, the study of plants as to their relative importance, and their commercial or medical value. In the gardens, the students will learn practically the processes and operations in the department of horticulture. Under agricultural chemistry will be considered the composition of soils, the relations of air and moisture to vegetable growth, the chem-

istry of farm processes and methods of improving soils." The labor in this institution is designed to be educational. Tuition is free to all students from the State.

MARYLAND.

The Agricultural College of this State was established several years before the congressional grant of lands was given. It is located at Hyattsville, on the line of the Baltimore and Ohio railroad, eight miles from Washington. The farm consists of 283 acres of land, which, together with the buildings that were erected, cost $100,000. The lands allotted to this State, amounting to 210,000 acres, were given to this institution. After an interruption caused by the war, it is again in operation, with a new corps of instructors. It has an academic and an agricultural course, the latter embracing "instruction in the schools of English, mathematics, and the sciences applicable to agriculture." The design of the faculty is to blend instruction in the theory and practice of agriculture with the usual training in schools which are devoted to letters alone. Thus all the students will be taught to some extent the theory and practice of agriculture. The trustees do not suppose that a young man while acquiring an education can make himself a practical farmer, but the system here adopted "has in it enough of the purely practical to put the student in the way of becoming a thoroughly informed agriculturist, and in this manner it is hoped that an ardent love of the noble pursuit of agriculture will be fostered." They add, that by this course of instruction they "hope to arrest and counter-work the tendency of a very large number of our best young men to abandon the real happiness and profit of rural pursuits for the fancied gains and pleasures of city life in commercial and other employments."

MASSACHUSETTS.

For a history of the Agricultural College of this State, readers are referred to an article in the report of this Department for 1868. The report of its trustees, made to the State legislature in January last, affords very gratifying evidence of progress. The grounds are being rapidly prepared for use by under-draining and fencing, and it is the intention of the trustees to "develop the professional character of the college as rapidly as possible, and so to command the attention, the respect, and the patronage of those for whose particular benefit it has been founded."

Four departments of instruction are proposed for all the students:

First. Such physical training as will promote their health and develop a vigorous manly form and a sound body. The students are instructed in the laws of health and trained by military drill, light gymnastics, and scientific excursions. At the same time, they are required to labor six hours each week without compensation. Besides this they may labor for wages, provided their studies are not neglected. Many of the pupils come from the families of farmers and require only instruction in improved methods of labor or the principles involved in them. Those who have never had the opportunity for labor must be taught it and learn in their own experience the practical application of theoretical instruction. All must be made to feel that there is dignity and happiness in labor.

Second. The college endeavors to establish in the minds and hearts of the pupils correct moral and religious principles, and good habits of life. The Bible is used as a text-book, and while denominational peculiarities are avoided, its teachings are regarded as the best rule for the conduct of life.

Third. It aims to promote the intellectual training of the students and to prepare them to exert an efficient influence for good in their future life. The mathematical studies which are pursued, the study of the great forces of nature, of botany, of animal life, of physical geography, and geology, as well as the study of mental philosophy, and the civil polity of the State and national governments, will all tend to strengthen and mature the intellect, while the stores of useful knowledge thus acquired will be a life-long source of the purest enjoyment.

Fourth. The great object for which the college was founded will be always prominent, viz, to make good farmers and gardeners. It is to teach the nature and proper treatment of soils; the proper method of tillage; the value of various fertilizers; the use of improved implements of husbandry; the best method of cultivating crops; the different breeds of animals; the rules of business; the management of the dairy; the culture of orchards, vineyards, and forest trees; and the theory and practice of landscape gardening.

MICHIGAN.

The national grant to Michigan was given to the Agricultural College which had been established by the State legislature at Lansing, in 1855. The farm on which it is located consists of 676 acres. The buildings consist of four dwellings for professors, a boarding hall, forty-three by eighty-two feet, and three stories in height, and a college building, fifty by one hundred feet, also three stories in height. The institution is in successful operation with a full corps of instructors and regular course of study, which was published in full in our report for 1868. The labor system, so happily introduced in many of the best industrial colleges, is here imperative on the students by the organic law of the college, which says: "Three hours of each day shall be devoted by every student of the college to labor upon the farm, and no person shall be exempt, except for physical disability."

MINNESOTA.

By act of the State legislature approved February 18, 1868, the funds to accrue to Minnesota under the congressional grant of lands for the establishment of a college of agriculture and the mechanic arts have been united with the endowment previously bestowed upon the University of Minnesota, which, by enactment of the legislature of 1855, is to embrace five or more colleges or departments, viz: A department of elementary instruction; a college of science, literature, and the arts; a college of agriculture and the mechanic arts, including military tactics; a college or department of law; and a college or department of medicine.

A three years' preparatory department has been in operation since 1866. Twenty students, most of whom passed through this course, are now pursuing the studies of freshmen in science or the arts. It is proposed to drop, as soon as practicable, the first year of this preparatory course, and to add to the two remaining years other two years, corresponding to the freshman and sophomore years of our ordinary colleges, thus forming a department to be called "the collegiate department," in which the student will be suitably prepared to enter any of the higher departments of the university.

On the 15th of September of the current year, three courses of the university proper, viz, the classical, the scientific, and the agricultural, were formed, with a freshman class. As the scientific and the agricultural courses are the same the first two years, the students in them have not been separated. All the departments are open alike to males and

females. The total attendance for the year ending December 1, 1869, in all the departments, has been 230, of which number 70 were females. In the scientific and the agricultural courses there were 89 students during the year, 24 of whom were females.

The faculty of the institution has been selected as follows:

William W. Folwell, M. A., president and professor of mathematics.

Rev. Gabriel Campbell, M. A., B. D., professor of moral and intellectual philosophy, and instructor in German.

Edward H. Twining, M. A., professor of chemistry, and instructor in natural sciences and in French.

Versol J. Walker, M. A., professor of the Latin language and literature.

Rev. Jabez Brooks, M. A., D. D., professor of the Greek language and literature.

Aris B. Donoldson, B. A., professor of rhetoric and English literature.

Major General R. W. Johnson, professor of military science.

D. A. Robertson, professor of agriculture.

Arthur Beardsley, C. E., tutor.

In September, 1868, a farm of 96 acres was purchased, and additions have since been made, increasing it to 143 acres. A competent farmer has been employed, and a portion of the land is now under cultivation. Thus far all the students who have desired work have been employed about the university building and grounds.

The president of the university and the board of regents evidence a disposition to give the agricultural course due prominence, and to carry out the intent of Congress in voting the land-grant endowment.

MISSOURI.

The general assembly of this State, at its late session, enacted a law providing for the location of the agricultural college at Columbia, Boone County, in connection with the State University. The citizens of Boone County have donated for the purposes of the institution a handsomely improved farm of 640 acres, with valuable buildings, and diversified with a variety of soil, well watered and timbered, and admirably adapted for the purpose to which it is to be devoted. In addition to the farm the citizens have contributed $30,000 in cash for the endowment of the college, which, with the cost of the farm, and a bonus of $117,000 originally given to secure the location of the University of Columbia, swells the donations of the people of Boone County to about $207,000.

The curators are making arrangements for putting the college in practical operation at the opening of the next scholastic year. They have also appointed agents to visit each 40 acres of 330,000 acres located under the congressional grant, and to make a record as to whether it is timber, prairie, bottom, or mineral land, valuing the same, noting everything desirable to be known by the curators; after which the land will be brought into the market, either for sale or lease, at the appraised value. A committee has also been appointed to visit other similar institutions in various parts of the country, to decide upon the best method of conducting the college, that mistakes, which have proved disastrous elsewhere, may be avoided.

The act of the legislature creates an agricultural and mechanical college, and a school of mining and metallurgy, each with a separate faculty, and the power to confer appropriate degrees. The students of the college are to be admitted to the libraries, museums, models, cabinets, and apparatus, and to all lectures and instructions of the university. The school of mines and metallurgy is to be located in the mineral dis-

trict of Southeast Missouri, and in the county which may donate the largest amount of money and land to secure its establishment.

NEW HAMPSHIRE.

This State received 150,000 acres of land, which was sold for $80,000. This sum was given to Dartmouth College, at Hanover, on condition that the college furnish a farm for the use of the new institution, together with the requisite buildings. The farm has been provided, and some progress has been made during the last year in the erection of a new building for the use of the students. It is to be 100 feet in length and 60 in breadth, and four stories in height. The farm is said to be well adapted to the use of the college.

NEW JERSEY.

"Rutger's Scientific School," a department of Rutger's College, New Brunswick, designated by the legislature of New Jersey as "the State college for the benefit of agriculture and the mechanic arts," and endowed with the proceeds of the sale of scrip inuring to the State under the congressional grant of 1862, is now in its fourth year of existence, its first regular term having commenced in September, 1866. The institution appears to have been conducted with gratifying efficiency, the State board of visitors, consisting of two members from each congressional district, in their last report to the governor, expressing their entire confidence in the management, and congratulating the people of the State upon the possession of such an institution of practical learning, and pronouncing it worthy of the support of all who are interested in industrial progress. In consideration of the income derived from this agricultural college land endowment, the trustees of the college receive into the scientific school and educate free of expense for tuition forty students, to be admitted upon the recommendation of the superintendent of schools in each county, and to be distributed among the several counties in proportion to population.

The faculty, as now constituted, is as follows: Rev. William H. Campbell, D. D., LL. D., president and professor of moral philosophy; George H. Cook, Ph. D., LL. D., vice-president and professor of chemistry, natural history, and agriculture; David Murray, A. M., Ph. D., professor of mathematics, natural philosophy, and astronomy; Rev. Theodore S. Doolittle, professor of rhetoric, logic, and mental philosophy; Josiah H. Kellogg, professor of civil engineering, and military superintendent; John T. Smock, A. M., professor of mining and metallurgy; George W. Atherton, A. M., professor of history, political economy, and constitutional law; Rev. Carl Meyer, D. D., professor of French and German; Francis C. Van Dyck, A. M., tutor in chemistry; Isaac E. Hasbrouck, A. M., tutor in mathematics.

Two distinct courses of study are provided, viz: a course in civil engineering and mechanics, and a course in chemistry and agriculture, either of which the student may elect. These courses extend through three years; the studies of the first year are the same in both courses, and are arranged with particular reference to the wants of those who desire, within a limited time, to prepare themselves as land surveyors. A special course in chemistry is also provided to meet the wants of such students as wish to devote themselves exclusively to this branch.

In addition to these regular courses, provision is made for partial students, who may enter at any time and select, under the direction and advice of the faculty, such studies as they may be found qualified to pursue, with classes already formed, subject to the general regula-

tions and discipline of the institution, and to such examinations as may be prescribed in each case. Such students, on leaving the institution, receive certificates stating the studies pursued and the attainments made.

The courses of study are as follows, in detail:

Course in Civil Engineering and Mechanics.

FIRST YEAR—*First term.*—1. Loomis's alegebra, from quadratic equations; 2. Loomis's geometry, from book IV; 3. Draughting, construction of problems; 4. Lectures on physiology; 5. Elocution, composition, and declamation; 6. French. *Second term.*—1. Algebra and geometry, finished; 2. Trigonometry, plane and spherical; 3. Geometrical draughting; 4. Zoölogy, history, French, composition, and declamation. *Third term.*—1. Surveying, with field exercises, descriptive geometery; 2. Draughting; 3. Botany, history, and French; 4. Composition and declamation.

SECOND YEAR—*First term.*—1. Analytical geometry; 2. Leveling and railroad curves; 3. Shades, shadows, and perspective; 4. Elements of chemistry and mineralogy; 5. Mental philosophy, German, composition, and declamation. *Second term.*—1. Differential and integral calculus; 2. Physics and general chemistry; 3. Shades, shadows, and perspective, construction of problems; 4. Mental philosophy, German, composition, and declamation. *Third term.*—1. Bartlett's mechanics; 2. Bartlett's optics and acoustics; 3. History; 4. German.

THIRD YEAR—*First term.*—1. Bartlett's mechanics; 2. Civil engineering; 3. History and Constitution of the United States; 4. Moral philosophy. *Second term.*—1. Civil engineering; 2. Stone-cutting; 3. Geodesy and practical astronomy; 4. Political economy. *Third term.*—1. Civil engineering, preparation of thesis; 2. Geology, lectures and geological excursions; 3. Architecture, lectures; 4. Military engineering; 5. International law.

Course in Chemistry and Agriculture.

FIRST YEAR.—The same course as in civil engineering and mechanics.

SECOND YEAR—*First term.*—1. Analytical geometry; 2. Leveling and railroad curves; 3. Shades, shadows, and perspective; 4. Elements of chemistry and mineralogy, with laboratory practice; 5. Mental philosophy, German, composition, and declamation. *Second term.*—1. Analytical chemistry and laboratory practice; 2. Physics and general chemistry; 3. Lectures on agriculture; 4. Mental philosophy, German, composition, and declamation. *Third term.*—1. Analytical chemistry, with laboratory practice; 2. Vegetable physiology; 3. History; 4. German.

THIRD YEAR—*First term.*—1. Mining and metallurgy; 2. Principles of agriculture, farm accounts; 3. History and the Constitution of the United States; 4. Moral philosophy. *Second term.*—1. Chemistry and laboratory practice; 2. Agriculture, its methods and products; 3. Geodesy and practical astronomy; 4. Political economy. *Third term.*—1. Geology, lectures and geological excursions; 2. Animal physiology; 3. Architecture, lectures; 4. Military engineering; 5. International law, preparation of thesis.

Special course in Chemistry.

FIRST YEAR—*First term.*—1. Elements of chemistry, text-book and lectures; 2. Blow-pipe analysis; 3. Elements of mineralogy. *Second term.*—1. Physics and chemistry, text-book and lectures; 2. Chemical analysis, qualitative. *Third term.*—1. Chemical analysis, qualitative and quantitative; 2. Vegetable physiology.

SECOND YEAR—*First term.*—1. Chemical analysis, analysis of minerals, ores, &c.; 2. Mineralogy, determinative. *Second term.*—1. Chemical physics, heat, electricity, magnetism, galvanism, and electro-magnetism, text-book and lectures; 2. Analysis of fertilizers and chemical products. *Third term.*—1. Lectures on geology; 2. Chemical analysis, special investigations.

Besides the attention given to military engineering and field fortifications by the graduating class, the members of all the classes are drilled by the military superintendent, during the autumn and summer terms, in infantry tactics, including the manual of arms, the arms and accoutrements being furnished by the State for this purpose.

Experience has convinced the faculty that the three years' course, as now provided for, is too short for the work to be done, and they have unanimously recommended to the trustees the addition of one year to the regular courses. If the suggestion should be adopted, it is proposed, to meet the wants of those students who may not be able to remain four years, to arrange the studies of the first two years as a course complete in itself. This short course, it is thought, will be sufficient for those who wish to become land surveyors or practical workers in any one of the leading branches of industry, while the full course will fit men for the higher departments of mining, engineering, architecture, and other scientific pursuits.

The purpose of the faculty is to make the scientific course as valuable in its way as the classical in its way, and to make it answer, as far as possible, every requirement of a truly liberal course of education, wishing not merely to turn out accomplished specialists, but also to furnish a body of men trained in the best principles and methods of investigation, and equally able to accumulate knowledge or to use it for the welfare of the community.

A peculiar feature of the law establishing this institution, and one worthy of emulation elsewhere, is a provision requiring that at least one lecture annually on agriculture shall be delivered by a professor of the college in each county of the State. These lectures have thus far been delivered by Professor George H. Cook, the professor of agriculture and chemistry, and also the efficient State geologist, and have excited a lively interest among farmers. The lectures are elementary, but, as many of their illustrations are drawn from circumstances peculiar to the State, they have a local interest, and supply information to agriculturists which they could not otherwise obtain. The first lecture delivered was "upon the condition and advantages of agriculture in New Jersey and the means for its improvement;" the second was upon "fertilizers," especial reference being made to those most abundant in the State; the third was upon "the results of the geological survey of New Jersey;" and that for 1869 was devoted to "agricultural chemistry," which was illustrated by chemical experiments, with explanatory references to the com position of soils, fertilizers, and various farm crops.

The delivery of these lectures has been followed, in several instances, by the formation of farmers' clubs, and the professor announces himself as always ready to answer inquiries and to furnish information that may be needed in carrying out the work of these useful associations, the formation of which he urges in all parts of the State.

Another condition of the law conveying the endowment was the purchase of an "experimental farm," without charge upon the State. This requirement has been met by the purchase of a tract of about one hundred acres adjacent to the college buildings. As an experimental farm the tract presents great advantages. When purchased it was an old

style farm—part dry tillable land, but extremely poor; part pasture land, too wet and heavy for tillage; and part in stumps, sprouts, and young timber.

The first efforts upon the farm were directed to bringing its whole area into profitable cultivation by draining the wet grounds, clearing and breaking up those which had never been plowed, and enriching the whole by manures and tillage. Twenty-four acres of land have been thoroughly underdrained, and twenty-five acres of new land have been broken up and partially cleared of stumps. One thousand two hundred and fifty bushels of gas lime, five hundred tons of greensand marl, and considerable quantities of stable manure, superphosphate of lime, bone-dust, poudrette, guano, &c., have been used upon the farm.

The early crops of the past season were good. The hay crop was very heavy; wheat on the old cultivated land yielded twenty-four bushels per acre; the early Goodrich potato, which ripened before the drought, yielded two hundred bushels to the acre; Indian corn that was acclimated was not injured by the dry weather, and produced fifty bushels to the acre. The stock of cattle upon the farm is approaching the pure Ayrshire, the cows proving themselves superior milkers. The design is to increase the herd until it is as large as the farm will support, and to use it in supplying milk for the market and in raising pure-blooded animals. Experiments with various fertilizers are in progress. In this connection Professor Cook, who has the supervision of the experimental farm, says that "the full worth of manures is not adequately appreciated by farmers," and adds that "all the experience of the college farm goes to show that there is no profit in cultivating poor land. Either make the land rich by means of manures, or do not waste labor in the attempt to till it. Raise clover, keep stock, or buy manure. One or the other of these must be done, or the farmer cannot raise paying crops."

The important question of deep and shallow plowing and that of surface manuring are being submitted to trial on the farm, and will be reported from time to time. The effects of underdraining have been marked as satisfactory. Fifty bushels of shelled corn to the acre have been raised on ground which two years before was a maple swamp; and fine grass and clover have been cut on a dry, mellow field which two years before was so wet that it could not be plowed. The old-style farm of one-third tillable land, one-third pasture, and one-third woods will soon be a farm every foot of which is plowed in its rotation and made to yield its share of the profits.

The president, in his annual report to the governor, states that "the trustees have considered it no part of their duty to turn the agricultural department of the institution into a school of manual labor. They have from the beginning proceeded upon the theory that, while the practical applications of science should be carefully kept in view in a course of instruction, the main business of a scientific school must be to teach scientific principles and the methods of scientific investigation; and that persons who desire to become skilled in the actual operations of farming must do it by engaging in the daily routine of a farmer's work."

He adds that "it is gratifying to find that their theory and practice thus agree in two important particulars with what the eminent Baron Liebig has recently stated to be the almost unanimous conviction among the best scientific agriculturists of Europe, viz., that the agricultural college ought always to be connected with institutions devoted to other departments of instruction, and that the attempt to keep up a system of manual labor had been proved to be impracticable, being now universally abandoned as a failure. No objection can be made, however, to

providing labor, as far as possible, for students who may wish in this way to help themselves; and it is hoped that the condition of the farm may soon be such as to furnish a considerable demand for voluntary labor of this kind."

There have been in the institution during the year fifty-three students, of whom three were from the State of New York, one from Pennsylvania, four from Japan, and the remaining forty-five from the State of New Jersey, sixteen of the number filling State scholarships. At the commencement in June the graduating class of nine members was admitted to the degree of Bachelor of Science. Theses were prepared by them and read before the State board of visitors on the following practical subjects: "Canals," "Geological changes effected by water," "Railroads," two on "Agriculture," "Strength of materials," "The railroad bridge over the Passaic at Newark," "Mineralogy," "Astronomy."

The demand in every department of industry for men of trained intelligence is shown by the fact that all the members of this class have already found honorable and remunerative employment in the work for which they had prepared themselves; and all, with a single exception, are employed in New Jersey, thus giving the State a direct return for her care of this institution. Two of the class are engaged in farming, one in surveying, three in new railroad enterprises, two upon railroads already established, and one as assistant engineer of the Indianapolis (Indiana) City water-works.

Applicants for admission to the full courses of study must be sixteen years of age, of good moral character, and must pass a satisfactory examination in English grammar and spelling, descriptive geography, physical geography, history of the United States, arithmetic complete, algebra to quadratic equations, and three books of plane geometry.

Candidates for advanced standing are examined, in addition to the preparatory studies, in those already pursued by the class they propose to enter.

The expenses per annum to students, other than those filling the State scholarships, are as follows: Tuition, $75; incidental expenses, $8; admission fee, $5; graduating fee, $7 50. Students in analytical chemistry are charged $15 additional per term for chemicals and use of apparatus. Board with furnished room can be obtained at $4 to $6 per week, and board without room at $3 to $5 per week.

OHIO.

After several years of conflict between various colleges of the State to secure the proceeds of the congressional grant, the legislature of Ohio has passed a law providing for the establishment of one independent college, to be styled the Ohio Agricultural and Mechanical College, the leading objects of which shall be the teaching of such branches of learning as are related to agriculture and the mechanic arts, without excluding other scientific and classical studies, and including military tactics.

The government is to be vested in a board of trustees, consisting of one member from each congressional district, to be nominated by the governor and confirmed by the senate, for a term of six years, one-third to be appointed every two years. The general management is to be intrusted to an executive committee of three. The board of trustees is authorized to make rules, to appoint officers, and to prescribe the compensation; but no debts are to be contracted without authority of the general assembly of the State.

The trustees are required to locate the college on or before the 1st of October, 1870, on lands not less in area than one hundred acres, cen-

trally situated, and accessible by railroad. No proposition for the location of the college is to be accepted unless accompanied by a donation of not less than $200,000, and of not less than one hundred acres of land. The endowment fund is to be kept intact. This fund, derived from the sales of land scrip, amounts, with accrued interest up to July, 1870, to $422,564 32.

The board of trustees has been organized by the election of V. B. Horton, of Meigs County, as chairman; Joseph Sullivant, of Columbus, treasurer; and R. D. Anderson, of Dayton, secretary. An address will be issued to the people of the State, inviting proposals for the location of the college. Summit County has already proposed to give two hundred acres of land and $400,000 in cash, while Franklin County offers $600,000 to induce the trustees to locate the college at Columbus. The endowment will doubtless be doubled by the liberality of parties desiring the location of the institution in their midst, and there is now every promise that the new college will prove a success, if energy and money will insure it.

PENNSYLVANIA.

The Agricultural College in this State appears to be emerging from its depressed condition, a condition caused, it is said in the last report of its trustees, by an attempt to elevate it into a literary institution, in which "scientific agriculture was sunk into a secondary object, and practical farming left optional with the student." The public seem to have been distrustful of it as a place of education, and the number of its students is still small. Its officers, however, have entered with energy on the work of restoring it to the confidence of the people, and the experience of the last year indicates their success. The college farm consists of four hundred acres, in a central part of the State, in a healthful climate, and the college building is of limestone, two hundred and forty feet in length, eighty feet in width, and five stories in height. It is heated with furnaces, and supplied with water. A garden of six acres has been trenched, and is highly productive. The orchard covers twelve acres, and is just coming into good bearing. The lecture rooms and laboratories are supplied with good apparatus. Three large laboratories are designed for the special use of the students, in which they may conduct experiments, and there is a good collection of minerals and geological specimens, especially illustrative of the geology of the State. It will be remembered that this college was established for the promotion of agricultural education before the congressional grant was given to it.

With all these appliances the trustees and the officers of the college have resolutely attempted to render it useful for the purposes for which it was at first established. Two courses of instruction are proposed: First. Agricultural, embracing the various branches of a sound English education; mathematics, so far as is necessary to surveying; chemistry, botany, natural philosophy, zoölogy, and regular instruction in practical agriculture. Second. The scientific course, adding to the studies already specified the higher departments of the same sciences, and a fuller course in mathematics.

Educational labor is required of all the students, both on the farm and in the laboratories. In the latter, after studying the science of chemistry, each student learns the use of apparatus and the methods of analysis, under the eye of a teacher, and performs a course of experiments applicable to his intended pursuit in life.

WEST VIRGINIA.

The proceeds of the land grant to this State ($90,000) have been devoted to the establishment of the "West Virginia University," which is now in successful operation, with literary, scientific, agricultural, and military departments. The university is located at Morgantown, the citizens of which place contributed $50,000 in grounds, buildings, and money for the purposes of the institution. The legislature of the State has also appropriated $16,000 per annum for the further endowment and for the current expenses of the university. The following course of study has been adopted for the agricultural department, though students in agriculture will recite with the other classes until their numbers warrant separate provision for them:

FIRST YEAR—*Fall term.*—Geometry, manual of agriculture, anatomy, physiology, and zoölogy; lectures on the chemistry, structure, and physiology of plants; on the water, atmosphere, and soil, as related to vegetables; on tilling, draining, and manuring. *Winter term.*—Trigonometry and spherical geometry, inorganic chemistry, history of English literature; lectures on domestic animals and their digestion, respiration, assimilation, and excretion; on the composition, preparation, and value of different kinds of food; on milk, butter, cheese, flesh, and wool, as agricultural products. *Spring term.*—Mensuration and surveying, organic chemistry, botany; lectures on horticultural and kitchen gardening; on the propagation, training, and culture of fruit trees, the vine, small fruits, and vegetables; excursions.

SECOND YEAR—*Fall term.*—Geology, moral philosophy, book-keeping; lectures on the staple grain, forage, root, and fibre crops of this and adjoining States, and their varieties, and the soils best adapted to them; on the preparation of soil, seeding, cultivating, harvesting, and preparing for market; on the origin and natural history of domestic animals; on entomology and the insects useful and hurtful to vegetation; excursions. *Winter term.*—Mechanic arts, political economy, history of civilization; lectures on the raising, care, characteristics, and adaptation of different breeds of domestic animals; on cattle for beef or draught, and sheep for wool or mutton; on horses, swine, and poultry; on pasturing, soiling, and stall-feeding; on tobacco, hops, and forestry. *Spring term.*—Constitution of the United States and of West Virginia, international law, general history; lectures on rural economy; on the history of agriculture, with sketches of the same in ancient and modern times, and foreign lands; on the adaptation of farming to soil, climate, market, and other natural and economical conditions; on the different systems of husbandry, such as stock, sheep, grain, and mixed farming; excursions.

The charge for tuition in the agricultural department is $8 per term of thirteen weeks, with $2 per term additional for contingencies. Board $3 50 to $4 per week.

WISCONSIN.

The national grant to Wisconsin was 210,000 acres. The lands were located within the State, and were given to the State university established at Madison. A farm has been purchased by the citizens of Dane County, at a cost of $40,000, and the agricultural college is now in operation as a branch of the university. The programme of studies and the list of officers, which were given in our annual report for 1867 and for 1868, show that the college is to be conducted in the interest of farmers, and not as a mere appendage of a literary institution. The excellent president of the university and the able corps of instructors give

promise of success to the effort to train an intelligent body of farmers for the noble pursuit of life in which they are to engage.

In closing this article we renew the expression of the pleasure with which we contemplate the progress of our industrial colleges during the last year. We regret that agriculture is not made prominent in all of them, yet all will be useful in educating the national mind, and in giving dignity and nobility to labor.

Most of the States lately in rebellion, having resumed their peaceful relations to the Union, have accepted the national land grant, and the Commissioner of the General Land Office is now issuing scrip for the portion allotted to them. We hope in our next annual report to have information to communicate in relation to the colleges to be established in them, and that all the States which have hitherto delayed their action in this regard will report to us the progress they have made.

CORNELL UNIVERSITY.

In the spring of 1865, the legislature of New York passed an act incorporating the Cornell University. By this act the grant of land made by Congress in 1862 to the State of New York, for the benefit of agricultural and mechanic arts, was given to the trustees of Cornell University upon compliance with certain conditions, of which the most important were that Ezra Cornell should give to the institution $500,000, and that provision should be made for the education, free of all charge for tuition, of one student from each Assembly district of the State. At the first meeting of the trustees after the passage of this act, Mr. Cornell complied with the conditions of the charter, and made an additional gift of over two hundred acres of land, with buildings, as a farm to be attached to the College of Agriculture, and of the Jewett collection in geology and paleontology, which had cost him $10,000. He has since made other gifts to the amount of $25,000, and has expended about $200,000 in purchasing the land scrip, and locating the lands for the university. The act further provides for the location of the Cornell University at Ithaca, Tompkins County, and for a board of twenty-four trustees. Of these, the governor of the State, the lieutenant-governor, speaker of the assembly, superintendent of public instruction, president of the State Agricultural Society, president of Cornell University, and the librarian of Cornell library, are trustees *ex officio*. Mr. Cornell himself and his oldest son are permanent trustees. The remaining fifteen are elected according to the provisions of the act of incorporation. By a special clause in the act of organization the graduates of the university, whenever they shall number one hundred, shall be entitled to fill the place, each year, of one of the retiring members. It is hoped that this feature will do much to insure constant vigor in the administration of the affairs of the institution.

The university is a part of the educational system of the State, and is bound by the terms of the act which created it to educate, free of all fees for instruction, one student from each of the one hundred and twenty-eight Assembly districts of the State.

The endowment of the university consists of two distinct funds. The original gift of the national government to the State of New York was in land scrip, covering 990,000 acres. Of this an amount of scrip represent-

ing 76,000 acres was sold before the foundation of the Cornell University, and the proceeds, $64,600, were deposited in the State treasury. Under the management of Mr. Cornell 293,000 acres in scrip have been sold, for a sum of $263,700, and scrip to the amount of 100,000 acres still remains unsold. The remainder of the scrip, 520,000 acres, has been located, and now constitutes an estate to be sold at such times and in such quantities as the trustees may decide. A small portion of it is situated in the States of Kansas and Minnesota, but by far the greater part lies in the State of Wisconsin, in the counties of Chippewa, Clark, Dallas, Dunn, and Eau Claire. It has been carefully selected, in tracts often bordering on large streams, has been thoroughly surveyed and mapped, and is nearly all embraced in the rich and valuable pine region of Wisconsin. Its timber alone gives it a constantly increasing value. The whole tract is estimated, at the present time, to be worth an average of $5 an acre, after defraying the expenses of its location and supervision, or a total of over $2,500,000. Portions of it could, even at this time, be sold at considerably more that $5 an acre. The proceeds of the sales of land scrip up to this time, deposited in the treasury of the State for the benefit of the university, amount in all to $328,300. The other portion of the university endowment consists of the sum of $525,000, given in cash by Mr. Cornell. It has been securely invested, and yields interest at the rate of seven per centum.

The estate attached immediately to the university consists of the farm and grounds, embracing more than 200 acres of excellent land. This tract lies on an upland to the east of Ithaca, nearly 400 feet above the surface of Cayuga Lake. Attached to the university farm are a farm-house, barns, and other outbuildings. The other structures in use for university purposes are: 1. Two four-story edifices, of light and dark stone, each 150 feet in length by 50 feet in breadth, built in a massive Florentine style of architecture, and occupied partly as dormitories, partly as lecture and cabinet rooms. 2. A four-story stone building, 180 by 100 feet, styled Cascadilla Place, and used principally for dormitories, faculty rooms, offices, and commons. 3. The laboratories, a structure 100 feet long, with wings at each end running back the same distance, containing agricultural, chemical, botanical, physical, and geological laboratories, together with lecture rooms, and temporary workshops. In addition to these the university makes use, to some extent, of the Cornell library building, in which the lectures of the non-resident professors are held, and in which the business office, or superintendency, and some of the cabinets occupy rooms.

The university library contains 25,000 volumes; of these 800 treat of agriculture, 150 of veterinary science, and 800 of the mechanic arts. The library also contains the publications of the Patent Office of Great Britain, numbering about 2,500 volumes. The reading room receives 200 journals and periodicals, printed in our own and in foreign languages. Of these about 40 treat of agricultural and mechanical subjects.

Among the museums of the university the following are especially valuable to agricultural and mechanical students. In the geological museum are comprised:

1. The Jewett collection in paleontology, embracing a very large collection of specimens, many of which have served as types for the descriptions and engravings in the State geological publications.
2. The duplicates of the State cabinets appropriated to the university under the law of 1868.
3. The collections made by Professor Hartt as geologist of the Agassiz expedition to Brazil, and by him deposited in the museum.

4. The Silliman collection in mineralogy, being the acquisition during many years of exploration, of purchase, and exchange of Professor Benjamin Silliman, jr., of Yale College.

The collections illustrative of botany, agriculture, and horticulture include the following:

1. The series of *modèles elastiques* of plants, on a magnificent scale, made by Auzaux, of Paris, and the two series of plant models designed and executed by Brendel, of Breslau.

2. The Rau models, being one hundred and eighty-seven models of plows, made at the Royal Agricultural College of Wurtemberg, under the direction of Professor Rau, and arranged and classified by him for the Paris Exposition of 1867.

3. Engravings and photographs of cultivated plants and animals obtained at the various agricultural colleges of Europe.

4. The Auzaux models of veterinary science and practice, being the entire series used at the imperial veterinary colleges of France and Russia.

5. A collection of the cereals of Great Britain, being a duplicate of that in the Royal Museum of Science and Art at Edinburgh, presented by the British government.

6. A collection of wools of upward of three hundred varieties, presented by Professor Wilson of the University of Edinburgh.

7. The Horace Mann herbarium, a *hortus siccus*, or collection of plants to the number of several thousand, purchased of the estate of the late Horace Mann by President White, and presented to the university by him.

8. Miscellaneous collections illustrating the materials, processes, and products of agriculture and horticulture, and the various operations in veterinary surgery, many of them prepared by the classes under the direction of Professors Wilder and Law.

9. A cabinet of tools and implements, either of the actual size or in the shape of models.

10. Besides the foregoing the agricultural student has access to the stables of Mr. Cornell, containing many specimens of choice imported stock of different races.

The collections in the museum of zoölogy, which are available for the educational purposes of the university, are made up of the following:

1. A remarkably well-mounted and carefully-classified collection in ornithology, principally American, made and presented to the university by Mr. Greene Smith, of Geneva.

2. The Newcomb conchological collection, made on the South Atlantic and the Pacific Coasts, and one of the most complete and admirably arranged in existence.

3. The *modèles elastiques* of Dr. Auzaux, of Paris, illustrative of comparative anatomy, physiology, and zoölogy.

4. The illustrative charts and diagrams, edited by Achille Comté, of Paris, and those published under the auspices of the Council of Education at London.

5. The Wilder entomological collection, deposited by Professor Wilder.

6. Anatomical models and specimens, deposited by Professors Wilder and Hartt.

Besides the models made at the university, the museum of technology and civil engineering comprises:

1. A collection of working models in brass and iron, illustrative of mechanical principles applied to machinery, and an extended series of

photographs for the same purpose, from the establishment of Schröder, of Darmstadt.

2. Another collection of working models in wood and iron, illustrative of intricate mechanical combinations and expedients, made under the direction of Professor Willis, of Cambridge, England, and of Professor Rigg, of the College of Mechanics, at Chester.

3. Models illustrating descriptive geometry and bridge and roof construction, made by Schröder.

4. The diagrams and charts issued with the sanction of the English committee of Council on Education.

5. Photographs and models from various sources.

The chemicals, apparatus, and instruments in use in the chemical laboratories have been recently procured with especial care in London, Paris, Heidelberg, Erfurt, Darmstadt, and Berlin. In this department are also the following:

1. A large amount of apparatus illustrative of optics and kindred branches, manufactured by Duboscq, of Paris.

2. A collection illustrative of natural philosophy in general, made at Paris by Deloeil, at Heidelberg by Desaga, and at Boston by Ritchie.

3. Much important apparatus deposited by Professor Crafts.

The following degrees are given to industrial students and students of natural science:

The degree of bachelor of science is conferred: 1. Upon such students as have successfully pursued the curriculum in science. 2. Upon such students as have completed a course of twelve trimesters, or four years, in either agriculture, the mechanic arts, civil engineering, chemistry, or natural science, or shall have successfully passed the examinations in those colleges or schools.

Licentiate certificates, or certificates of proficiency, are conferred upon all students who have pursued a special course in any branch of knowledge. They are given upon the recommendation of the deans of the respective colleges.

A student who has pursued an elective or optional course of study equivalent, in the judgment of the faculty, to any one of the general courses, can receive one of the usual baccalaureate degrees. Applications for degrees by such students must be made to the president of the university, accompanied by a statement of the examinations passed, and of the number of trimesters spent in the university.

The degree of master of science, or an equivalent degree, is conferred upon such bachelors of science as may exhibit proof, satisfactory to the faculty, of proficiency in general science or in any special science.

The degree of doctor of philosophy is conferred upon such bachelors of arts, of philosophy, or of science as have completed a meritorious original investigation in chemistry.

Among many prizes offered, the following are for the encouragement of industrial and scientific students: To the student of the voluntary labor corps in agriculture who, without neglecting his other university duties, shall show himself most efficient, practically and scientifically, upon the university farm, $50; to the second in merit, $20; to the third in merit, $10. To the student in the volunteer labor corps in the mechanic arts who, without neglecting his other university duties, shall show himself most efficient, practically and scientifically, in the university workshops, $50; to the second in merit, $20; to the third in merit, $10. Thirty dollars to the student showing the most satisfactory progress during the first year of the course in science; $20 to the second in merit. One hundred dollars for the most meritorious original investiga-

tion in general chemistry; $20 for the most meritorious chemical work in the laboratory. Thirty dollars to the student of the course in science showing the most satisfactory progress in general and analytical chemistry; $20 to the second in merit. Thirty dollars for the most meritorious report or thesis upon an investigation made in chemistry as applied to agriculture; $20 to the most meritorious student in chemistry as applied to agriculture, who has shown satisfactory progress in the regular studies of the university. Thirty dollars to the most meritorious student in practical mechanics and physics; $20 to the second in merit. Thirty dollars to the most meritorious student in civil engineering; $20 to the second in merit. Thirty dollars to the most meritorious student in botany and horticulture; $20 to the second in merit; $10 to the third in merit. Thirty dollars for the most meritorious report or thesis upon an original investigation in agriculture; $20 for the second in merit. Thirty dollars for the most meritorious report or thesis upon an original investigation in geology; $20 for the second in merit. Thirty dollars for the best series of notes in Professor Wilder's course of physiology and hygiene; $20 for the second in merit; $10 for the third in merit. Twenty dollars to the most meritorious student in general zoölogy; $10 to the second in merit. Twenty dollars to the most meritorious student in veterinary surgery; $10 to the second in merit.

Candidates for admission or matriculation are required to be at least sixteen years of age, to be of good character, and to possess such physical health and strength as will enable them to pursue the studies of the course which they propose to enter. All candidates, no matter what may be the course of study which they intend to pursue, must pass a thoroughly satisfactory examination in the following subjects: 1st, geography; 2d, English grammar, including orthography and syntax; 3d, arithmetic, and algebra to quadratic equations. This admits to all the courses, except the classical and philosophical, which require preparation in Latin and Greek. Algebra is excepted from this requirement in the case of students who take the two years' course in agriculture.

To all undergraduates not exempt under the charter as State students, the university fees for instruction are $10 for each trimester, or $30 for the year. No matriculation or entrance fees are required, nor is any discrimination made between students coming from different States. The total expense of living in the university buildings, including room, fuel, lights, rent of furniture, and board at commons, is fixed for the present at 78 cents a day, or $5 46 a week. The expense of living in the town, outside of the university buildings, varies for board, room, fuel, and lights, from $4 to $6 a week. In many cases students, by the formation of clubs, have been able to reduce their expenses to sums ranging from $2 to $3 50 a week for board and room rent.

THE COURSE IN SCIENCE.

FIRST YEAR—*Fall trimester.*—Algebra, completed; the English language and literature; French, and physiology and hygiene. *Winter trimester.*—English language and literature; French, geometry, and history. *Spring trimester.*—Botany; English language and literature; French; and geometry and conic sections.

SECOND YEAR—*Fall trimester.*—Chemistry; the English language and literature; experimental mechanics; German, and trigonometry. *Winter trimester.*—Analytical geometry; chemistry; the English language and literature; German, and physics. *Spring trimester.*—Chemistry;

differential calculus; the English language and literature; German, and physics.

THIRD YEAR—*Fall trimester.*—The English language and literature; integral calculus; psychology; and optional studies in the modern languages and physical science. *Winter trimester.*—Higher mathematics, and optional studies in the modern languages and physical science. *Spring trimester.*—Optional studies in the modern languages, and in the historical, moral, and physical sciences.

FOURTH YEAR—*Fall trimester.*—Astronomy; history; military engineering; natural history; physical geography, and rhetoric and oratory. *Winter trimester.*—Moral philosophy; military science; political economy; rhetoric and oratory, and optional studies in the physical sciences. *Spring trimester.*—English and general literature; history; international law and Constitution of the United States; military law, and rural economy and architecture.

THE COURSE IN PHILOSOPHY.

FIRST YEAR—*Fall trimester.*—Algebra completed; the English language and literature; German; and physiology and hygiene. *Winter trimester.*—The English language and literature; geometry; history, and Latin. *Spring trimester.*—Botany; the English language and literature; German; Latin, and trigonometry and mensuration.

SECOND YEAR—*Fall trimester.*—Chemistry; the English language and literature; experimental mechanics; French, and Latin. *Winter trimester.*—Chemistry; the English language and literature; French; physics, and, at the option of the student, either analytical geometry, history, German, Italian, or Spanish. *Spring trimester.*—Chemistry; the English language and literature; physics, and, optionally, either differential calculus, history, Latin, or the modern languages.

THIRD YEAR—*Fall trimester.*—The English language and literature; psychology, and, optionally, either Latin or the modern languages. *Winter trimester.*—The English language and literature; zoölogy, and, optionally, either Latin or the modern languages. *Spring trimester.*—Acoustics and optics; embryology; the English language and literature; logic, and the modern languages.

FOURTH YEAR—*Fall trimester.*—Geology; the history of philosophy; the modern languages, and rhetoric and oratory. *Winter trimester.*—Astronomy; moral philosophy; philosophy of history; political science; rhetoric and oratory; science of language, and, optionally, military science. *Spring trimester.*—English and general literature; history; natural history; the Constitution of the United States; and rural economy and architecture, and, optionally, military law.

COURSES IN AGRICULTURE.

The full course of twelve trimesters, or four years.

FIRST YEAR—*Fall trimester.*—Algebra; English language and vocal culture; French, and human and comparative physiology. *Winter trimester.*—English language and vocal culture; French; geometry; history, and zoölogy. *Spring trimester.*—Botany; embryology; English language and vocal culture; French, and trigonometry.

SECOND YEAR—*Fall trimester.*—Chemistry; English literature and elocution; experimental mechanics; German; psychology, and vegetable physiology. *Winter trimester.*—Chemistry; elementary geology; English literature and elocution; German; philosophical anatomy, and physics. *Spring trimester.*—Acoustics and optics; chemistry; bookkeeping or laboratory practice; German, and physics.

THIRD YEAR—*Fall trimester.*—Agricultural and economic botany; agricultural chemistry; English literature and rhetoric, and veterinary anatomy and physiology. *Winter trimester.*—Agricultural chemistry; agricultural and economic botany; English literature and rhetoric; horticulture, and veterinary medicine and surgery. *Spring trimester.*—Agricultural chemistry; arboriculture; English literature and rhetoric; landscape gardening, and veterinary medicine and surgery.

FOURTH YEAR—*Fall trimester.*—Agricultural chemistry; agricultural geology; comparative anatomy or history; practical agriculture, and rhetoric and oratory. *Winter trimester.*—Agricultural architecture; agricultural technology; astronomy; practical agriculture; moral philosophy and political science; and rhetoric and oratory. *Spring trimester.*—Agricultural mechanics; architecture and rural economy; practical agriculture; constitutional law; and meteorology.

A course of nine trimesters, or three years.

FIRST YEAR—*Fall trimester.*—Chemistry; English language and vocal culture; human and comparative physiology; vegetable physiology; and either algebra, experimental mechanics, or the modern languages. *Winter trimester.*—Chemistry; elementary geology; English language and vocal culture; history; zoölogy; and either geometry, modern languages, or physics. *Spring trimester.*—Book-keeping; botany; chemistry; embryology; English language and vocal culture, and either modern languages, physics, or trigonometry.

SECOND YEAR.—Same as the third year of the full course.

THIRD YEAR.—Same as the fourth year of the full course.

Those taking mathematics or physics, during the first year, will be required to devote eight hours weekly to laboratory practice, while those who take the modern languages will be obliged to practice but two hours a week.

A course of six trimesters, or two years.

FIRST YEAR—*Fall trimester.*—Agricultural chemistry; English language and vocal culture; human and comparative physiology; veterinary anatomy and physiology, and either experimental mechanics or additional laboratory practice in chemistry and veterinary surgery. *Winter trimester.*—Agricultural chemistry; English language and vocal culture; veterinary medicine and surgery; and either physics, zoölogy, or additional laboratory practice in chemistry or veterinary surgery. *Spring trimester.*—Book-keeping; botany; English language and vocal culture; horticulture; veterinary medicine and surgery; and either agricultural chemistry or embryology.

SECOND YEAR—*Fall trimester.*—Agricultural chemistry; agricultural and economic botany; English literature and elocution; practical agriculture, and vegetable physiology. *Winter trimester.*—Agricultural architecture; agricultural and economic botany; agricultural technology; English literature and elocution; general agriculture; and horticulture. *Spring trimester.*—Arboriculture; agricultural mechanics; architecture and rural economy; practical agriculture; landscape gardening; and meteorology.

Text books.—Caldwell's Agricultural Chemical Analysis, Johnson's How Crops Grow, Gray's School and Field Book of Botany, Gray's Manual of Botany, Darlington's Useful Plants, Thomas's American Fruit Culturist, Kemp's Landscape Gardening, Gamgee and Law's Anatomy of the Domestic Animals, Gamgee's Domestic Animals in Health and Disease.

COURSES IN MECHANIC ARTS.

The full course of twelve trimesters, or four years.

FIRST YEAR—*Fall trimester.*—Algebra; English language, literature, and vocal culture; French, and linear draughting. *Winter trimester.*—English language, literature, and vocal culture; French, geometry, and linear draughting. *Spring trimester.*—Geometry and conic sections; French, and linear draughting.

SECOND YEAR—*Fall trimester.*—Chemistry; English literature and rhetoric; experimental mechanics; German, and trigonometry and mensuration. *Winter trimester.*—Analytical geometry; chemistry; German; physics, and lectures on the strength and preservation of materials. *Spring trimester.*—Chemistry; differential calculus; elements of machinery; German; lectures on the materials employed in the construction of machinery; and physics.

THIRD YEAR—*Fall trimester.*—Descriptive geometry, with shades, shadows, and perspective; integral calculus, and lectures on the tools and processes employed in the construction of machinery. *Winter trimester.*—Draughting, with the study of colors; Peck's mechanics; the special study of the mechanical relations of heat, and building and building materials. *Spring trimester.*—Acoustics and optics; draughting; mechanism, and the machinery of transmission.

FOURTH YEAR—*Fall trimester.*—Study of the moving forces employed in the arts, with special reference to water-wheels and steam-engines; machine draughting, and lectures on metallurgy. *Winter trimester.*—Machine draughting; moral philosophy; political science, and the study of the steam-engine. *Spring trimester.*—Architecture; machine draughting, and rural economy.

A course of nine trimesters, or three years.

FIRST YEAR.—The same as in the full course.

SECOND YEAR—*Fall and winter trimesters.*—The same as in the full course. *Spring trimester.*—Chemistry; draughting; the materials used in construction; mechanism and machinery of transmission; and physics.

THIRD YEAR—*Fall trimester.*—Descriptive geometry; lectures on tools and processes; the study of moving forces, and physics. *Winter trimester.*—Peck's Mechanics; the relations of heat, and the study of the steam-engine. *Spring trimester.*—Acoustics and optics; machine draughting; and preparation of thesis.

The courses are arranged on a basis of three class exercises daily to each student; but those who can accomplish more may take additional studies. Students who join the labor corps are permitted to substitute it for one class exercise. Manual labor is optional with the student, and is paid for at its market value.

Military exercises are made obligatory on all able-bodied students. If, however, it appears that a student needs the time required for military drill to earn money for his support in school, he can be excused from military exercise.

The course of study in military science comprises: 1. Military engineering. 2. The art of war. 3. Military law. The course is entirely optional.

A student cannot receive any degree from the university without having passed a satisfactory examination in the course of lectures on general agriculture, to be given each year. That course is delivered this year by J. Stanton Gould.

By an examination of the various courses of study laid down it will

be apparent that such studies are prominent as tend to cultivate rural tastes, and to create an interest in the scientific and industrial pursuits of our country. While the whole number of students in the university is five hundred and sixty-three; only forty-five are in the classical course.

The resident professors and assistant professors number thirty. The non-resident professors who give courses of lectures on particular subjects are Louis Agassiz, LL. D.; George William Curtis, M. A.; Theodore W. Dwight, LL. D.; John Stanton Gould; James Russell Lowell, M. A.; Goldwin Smith, M. A., Oxon.; Bayard Taylor, M. A.

The following gentlemen comprise the faculty of agriculture: President, Andrew D. White, LL. D.; Hon. George Geddes; George C. Caldwell, B. S., Ph. D.; Charles Fred. Hartt, M. A.; James Law, F. R. V. C.; Albert N. Prentiss, M. S.; John Stanton Gould; Burt G. Wilder, B. S., M. D.; Lewis Spaulding.

The farm contains two hundred and six acres of rough, strong land. With the exception of a few acres it is capable of profitable cultivation. A greater variety of good soils can rarely be found within the same area. The timber is mainly white pine, yellow pine, oak, chestnut, and hickory. Among the flowering wild plants the azalea, laurel, hazel, and arbutus are abundant.

The amount invested in live stock, apart from the Cornell herd, Devons, Durhams, &c., is $1,845; in implements, $563 67; in seeds, feed, and current expenses for farm products, $1,790 60; expense for 8,636$\frac{3}{4}$ hours' work by students, at 15$\frac{2}{5}$ cents per hour, $1,329 94; total cost of farm products, $3,120 54; wholesale value of farm products, $4,358 50; balance in favor of farm products, $1,237 96.

The farm has been occupied as follows: With hoed crops, 32.69 acres; meadow, 96.14 acres; winter wheat, 13.42 acres; pasture 22.90 acres; woodland, 14.49 acres; orchard, 5.32 acres; buildings, grounds, and roads, 21.12 acres. Farm operations were commenced March 16, 1869.

The whole amount of money paid by the university for the labor of students during the year is $8,077 61. Work is given to them in the boarding hall as janitors, carpenters, masons, printers, librarians, surveyors, farmers, and as common laborers.

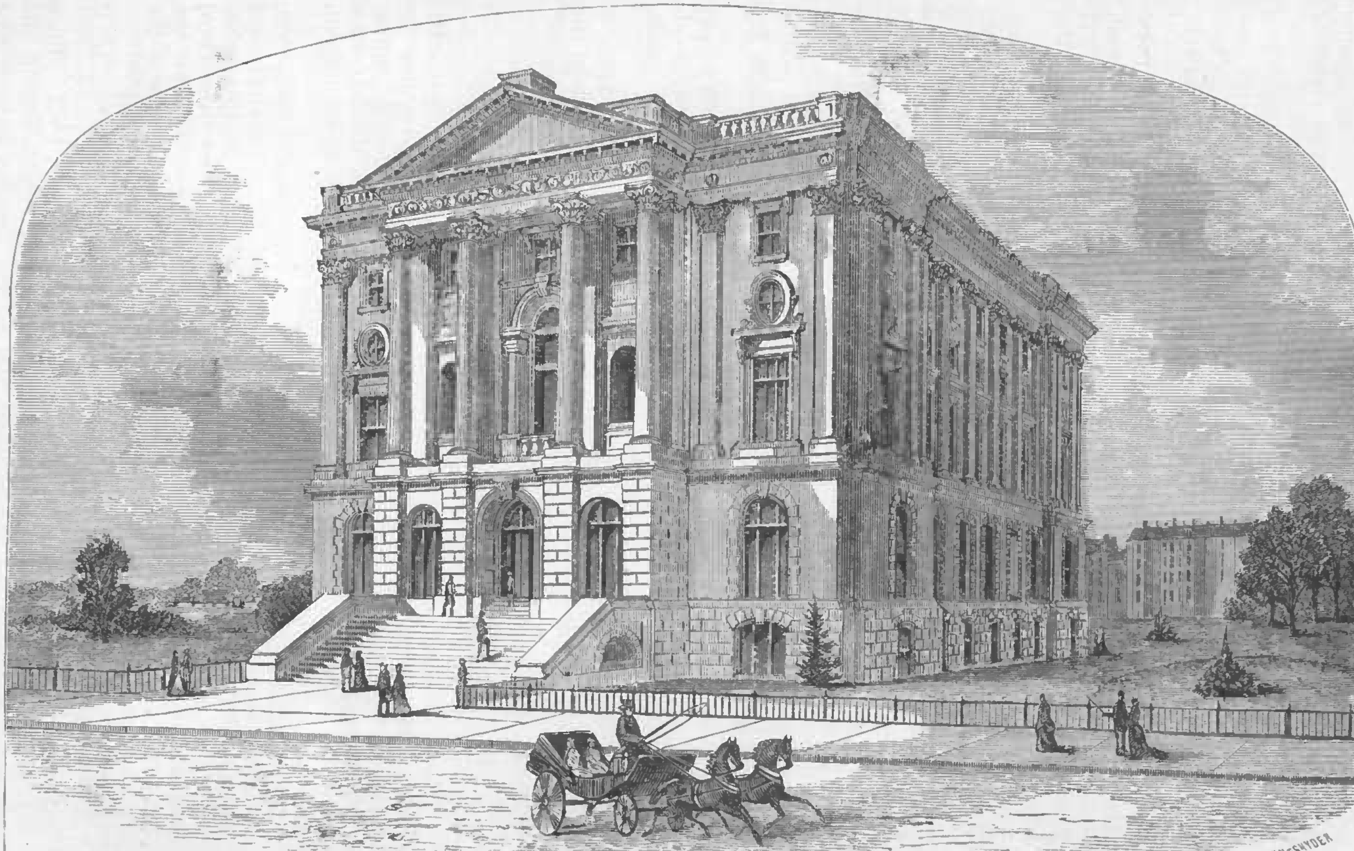
MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The act of incorporation, approved April 10, 1861, names this institution the Massachusetts Institute of Technology, and provides for maintaining a society of arts, a museum of arts, and a school of industrial science, and for aiding generally, by suitable means, the advancement, development, and practical application of science in connection with arts, agriculture, manufactures, and commerce.

The institute shares the benefits of the act of Congress of July 2, 1862, giving public lands to the States in aid of instruction in agriculture and the mechanic arts. Under an act of the general court of Massachusetts, approved April 27, 1863, it receives from the State "one-third part of the annual interest or income which may be received from the fund created under and by virtue of the 130th chapter of the acts of the 37th Congress, at the second session thereof, approved July 2, 1862."

I. THE SOCIETY OF ARTS OF THE INSTITUTE.

The first meeting of this society was held December 17, 1862. Since that time it has continued to hold two meetings a month during the successive sessions; the one hundred and eighth meeting having been



INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

PLATE XXXVIII.

held January 20, 1870. At these meetings new inventions, products, and processes are discussed, written and oral communications and discussions are made on the condition and progress of the various departments of industry, and on the wide range of the applications of science to the useful and industrial arts. The society now numbers between three and four hundred members.

II. THE MUSEUM OF ARTS OF THE INSTITUTE.

The collections of this museum are, as yet, almost entirely confined to casts, models, photographs, drawings, and the necessary appliances to carry on the instruction in the several professional departments of the school of the institute. The collections are arranged under the following heads:

The Architectural Museum.—A large number of photographs, prints, drawings, and casts has been collected for this department by means of a special fund raised for the purpose. This collection includes a number of English and French water-colors, mostly of architectural subjects, several lithographic publications issued by architectural students in England and on the continent, and photographs from the competition drawings for the foreign offices, the law courts, and the national gallery in London, and others from French competition for public buildings, and from the *Concours* of the *École des Beaux-Arts.*

The collection of casts comprises both architectural details and specimens of carving and sculpture, illustrating almost every period of art.

To these collections the following additions have been made by gift: A considerable collection of photographs and lithographs of great interest, presented to the Institute by French and English architects, taken from their own works and from their drawings.

A complete series of drawings, mostly presented by Ernst Benzon, of London, formerly a merchant of Boston, illustrating the course of architectural instruction in the *École des Beaux-Arts* in Paris, *Esquisses-Esquisses*, *Projéts Rendus*, *Projét d'Ordre*, *Projét de Construction*, *Grand Prix de Rome*, *Envoi de Rome.*

Specimens of modern English stained glass and tilework, partly purchased and partly presented by the makers, with cartoons and drawings illustrating the processes of the manufacture.

Museum of descriptive geometry and mechanics.—The collections of this museum consist of models in wood, in metal, and in plaster, besides lithographs, photographs, and manuscript drawings, arranged for convenience in the following groups. Some of these groups contain one or two hundred models, others only a few typical ones; it is, however, proposed to add from time to time such as may be required for the purposes of instruction.

Descriptive geometry.—This group includes models in relief, illustrating the problems of position of the point, the right line, and the plane; polyhedrons, single-curved, double-curved, and warped surfaces, with their sections and intersections, shades, shadows, and reflections.

Stone-cutting.—Models representing grained and cloistered arches, domes, staircases, &c., with detached voussoirs.

Carpentry.—Models of joints, frames, roofs, centers for bridges, &c.

Applied mechanics.—Plaster models, exhibiting the strongest forms of beams to resist extension, compression, and flexure; casts of Saint Vennant's models, showing the changes of form which prismatic bodies undergo when subjected to flexure and to torsion.

Cinematics.—Models of the contrivances for transmitting, transform-

ing, and modifying motions in machines, such as wheel-work, link-work, wrapping connectors, cams, &c.

Machinery.—Models and other illustrations of gas-engines, steam-engines, boilers, fire-grates, &c. Through the liberality of Erastus B. Bigelow the museum has been supplied with a number of highly finished models made by Schröder, of Darmstadt, representing the parts of machines, such as axles, cranks, eccentrics, cross-heads, &c., lifting machines, such as crab-engines, cranes, pumps, presses, &c., and hydraulic motors, such as water-wheels and turbines, and a water-pressure engine.

Manuscript drawings.—These include *Projéts de Concours* of the *École des Ponts et Chaussées* in Paris; also those relating to descriptive geometry and the construction of machines, given at the Polytechnic School at Carlsruhe. The collections also comprise about twelve hundred lithographs, including models for linear design and perspective, and for shading and tinting in India ink and water colors. Portfolio of the *Corps des Ponts et Chaussées.*

Mining engineering.—This department contains a typical set of models of mining machinery, chiefly from Freiberg, Saxony. They are designed mainly to illustrate the principles of the various processes of mining and ore-dressing, but combine also the latest improvements in machines. The collection of ores and vein stores is constantly receiving additions from the various mining regions. This department also contains the very valuable scientific library and the large and well-selected geological collection of the late Professor Henry D. Rogers, of the University of Glasgow, and presented to the Institute by Mrs. Rogers. This collection is made up chiefly of fossils and rock specimens from American localities. Accompanying this collection are many diagrams and maps of great value for the lecture room. The departments of civil engineering, chemistry, and physic contain large and well-selected collections of apparatus and instruments, which are rapidly increasing.

III. THE SCHOOL OF THE INSTITUTE.

This school was opened in February, 1864, and now contains over two hundred students. It provides a four years' course of scientific and literary studies and practical exercises, embracing pure and applied mathematics, the physical and natural sciences, with their applications, drawing, the English language, mental and political science, French and German. The course is so selected and arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for the professions of the civil and mechanical engineer, chemist, metallurgist, engineer of mines, architect, and teacher of science. All the studies and exercises of the first and second year are pursued by the whole school. At the beginning of the third year each student selects one of the following special courses of study: 1. A course in mechanical engineering. 2. A course in civil and topographical engineering. 3. A course in chemistry. 4. A course in geology and mining engineering. 5. A course in building and architecture. 6. A course in science and literature. These courses differ widely, but certain general studies are common to them all. It is intended to secure to every student, whatever his special course of study, a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object. The course in science and literature differs from the others in not having so distinctly a professional character. It offers a sound education, founded upon the sciences and modern literature, and furnishes, with its wide range of elective studies,

a suitable preparation for any of the departments of active life, or for teaching science. The institute also provides courses of evening instruction in the main branches of knowledge above referred to, for persons of either sex who, being unable to study during the day, desire to avail themselves of systematic evening lessons or lectures.

To be admitted to the first year's class the student must have attained the age of sixteen years, and must pass a satisfactory examination in arithmetic, so much of algebra as precedes equations of the second degree, plane geometry, English grammar, and geography.

In order to enter the second year's class, the student must be at least seventeen years of age, and must pass a satisfactory examination upon the first year's studies, besides passing the examination for admission to the first year's class; and a like rule applies to the case of students seeking admission into the classes of the succeeding years.

A knowledge of the Latin language is not required for admission; but the study of Latin is strongly recommended to young men who propose to enter this school.

Examinations for admission to the first year's class are held on the first Monday in June, and on the Thursday preceding the first Monday in October, at 9 a. m.

To make the opportunities of instruction as widely accessible as possible, students will be allowed to enter special divisions of any one of the courses; as, for example, the classes of mathematics, of engineering, of chemistry, of physics, or of mining and metallurgy, on giving satisfactory evidence that they are prepared to pursue such special studies with advantage.

The experience of the past year has resulted in the following course of instruction:

First year.

Mathematics.—Algebra; solid geometry; mensuration; plane trigonometry; applications of trigonometry to navigation. *Physics.*—Sound; heat. *Chemistry.*—Experimental study of general inorganic chemistry. *English.*—Composition; history and structure of the language. *German.*—Grammar and translation. *Descriptive geometry.*—Problems of position relative to the point, the right line, and the plane. *Mechanical drawing.*—Use of instruments, water-colors, and India-ink; graphical construction of problems in geometry, trigonometry, and descriptive geometry. *Free-hand drawing.*—With chalk and crayons; machinery; ornamentation.

Second year.

Mathematics.—Spherical trigonometry; analytic geometry of two and three dimensions; first principles of the differential and integral calculus. *Descriptive astronomy.*—The earth; the sun; time; gravitation; the moon; planets; comets; nebulæ; constellations. *Surveying.*—Field-work; plotting surveys; computing areas; plans. *Physics.*—Light; magnetism; electricity. *Chemistry.*—Qualitative analysis; organic chemistry. *English.*—Composition; reading; history of the language. *German. Descriptive geometry.*—Projections; perspective; shades and shadows. *Mechanical drawing.*—Geometry; perspective and isometric drawing. *Free-hand drawing.*—Machinery; ornamentation; landscape.

Third year.

I. Course in mechanical engineering.

Mechanism.—The principles of machinery. *Mathematics.*—Differential and integral calculus; analytic mechanics. *Applied mechanics.*—

Strength of materials; friction and rigidity; cinematics; dynamics of solids; hydrostatics and hydro-dynamics; thermo-dynamics; useful effect of machines. *Descriptive geometry.*—Applications to masonry, carpentry, and machinery. *Drawing.*—Machinery. *Physics.*—Laboratory practice. *Geology.*—Physiographic geology; lithology; outline of geological history; dynamical geology. *English.*—Logic; rhetoric; history of English literature. *Constitutional history.*—England and the United States. *German.*

II. Course of civil and topographical engineering.

Engineering.—Survey, location, and construction of roads, railways, and canals; measurement and computation of earth-work and masonry; supply and distribution of water; drainage; hydrographical surveying; river and harbor improvements; field practice. *Mathematics.*—Differential and integral calculus; analytic mechanics. *Applied mechanics.*—Stress, stability, strength and stiffness. *Spherical astronomy.*—Higher geodesy; latitude and longitude. *Descriptive geometry.*—Applications to masonry and carpentry. *Drawing.*—Plans, profiles, elevations, sections, &c. *Physics.*—Laboratory practice. *Geology.*—Physiographic geology; lithology; outline of geological history; dynamical geology. *English.*—Logic; rhetoric; history of English literature. *Constitutional history.*—England and the United States. *German.*

III. Course in chemistry.

Industrial chemistry.—Study of chemical manufactures, glass, pottery, soda-ash, acids, soap, gas, &c.; the arts of dyeing calico, printing, tanning, brewing, distilling, &c. *Metallurgy.*—Metallurgical processes, constructions, and implements. *Assaying.*—Wet and dry ways.—*Descriptive and determinative mineralogy.*—Use of the blow-pipe.

The foregoing studies are elective; each student must select one or more of them. The following studies are required:

Quantitative chemical analysis.—Laboratory practice. *Drawing.*—Chemical or metallurgical apparatus; plans of works. *Physics.*—Laboratory practice. *Geology.*—Physiographic geology; lithology; outline of geological history; dynamical geology. *English.*—Logic; rhetoric; history of English literature. *Constitutional history.*—England and the United States. *French,* (or Spanish.) *German.*

IV. Course in science and literature.

Mathematics.—Differential and integral calculus; analytic mechanics. *Chemistry.*—Quantitative analysis; pure and applied chemistry. *Physics.*—Physical research. *Architectural design.*—The elements of design; the principles of composition; exercises; the study of executed works.

The foregoing studies are elective; each student must select one or more of them. The following studies are required:

History.—Guizot's Histoire Générale de la Civilisation en Europe. *Drawing.*—Subjects determined by each student's choice of studies. *Physics.*—Laboratory practice. *Geology.*—Physiographic geology; lithology; outline of geological history; dynamical geology. *English.*—Logic; rhetoric; history of English literature. *Constitutional history.*—England and the United States. *French,* (or Spanish.) *German.*

Fourth year.

I. Course of mechanical engineering.

Machines.—Strength and proportions of the parts of a machine, hand machinery, cranes, derricks, pumps, turn-tables, &c. *Motors.*—Hydraulic motors; water-wheels; water-pressure engines; power and

strength of boilers. *Steam engines.*—Stationary, locomotive, marine, air, and gas engines. *Building materials.*—Stones, bricks, mortars, and cements. *Descriptive geometry.*—Applications to masonry, carpentry, and machinery; modeling. *Drawing.*—Machines, working plans, and projects of machinery, mills, &c. *Political economy.* *Natural history.*—Zoölogy, physiology. *French,* (or Italian.) *German.*

II. Course in civic and topographical engineering.

Engineering.—Structures of wood: Framing, trusses, girders, arches, roofs, bridges. Structures of stone: Foundations, retaining walls, arches, bridges. Structures of iron: Foundations, beams, girders, columns, roofs, bridges; field-practice. *Machinery and motors.*—Hand machinery, water-wheels, boilers, steam-engines. *Building materials.*—Stones, bricks, mortars, and cements. *Descriptive geometry.*—Applications to masonry and carpentry. *Drawing.*—Plans, profiles, elevations, sections, &c. *Political economy.* *Natural history.*—Zoölogy and physiology. *French,* (or Italian.) *German.*

III. Course in chemistry.

Chemistry.—Pure and applied; quantitative analysis; preparation of chemical products; special researches. *Building materials.*—Stones, bricks, mortars, and cements. *Drawing.*—Apparatus, machinery, and plans of works. *Political economy.* *Natural history.*—Zoölogy and physiology. *French,* (or Italian.) *German.*

IV. Course in mining engineering.

Mining.—The useful minerals, modes of occurrence, prospecting, boring, blasting, sinking shafts, timbering, walling and tubbing, driving levels, methods of mining, ventilation, lighting, winding machinery, ladders, and man-engines, underground transportation, pumps, dressing and concentration of ores, crushers, stamps, washers, amalgamators, &c.; details of American mining. *Machinery and motors.*—Hand machinery, water-wheels, boilers, steam-engines. *Engineering.*—Structures of wood, stone, and iron: Foundations, walls, arches, domes, beams, trusses, girders, roofs. *Chemistry.*—Quantitative analysis; laboratory practice. *Geology.*—Historical geology; paleontology; detailed study of American geology. *Building materials.*—Stones, bricks, mortars, and cements. *Drawing.*—Geological maps and sections; plans and sections of mines, quarries, and other open workings; mining machinery and implements. *Political economy.* *Natural history.*—Zoölogy and physiology. *French,* (or Italian.) *German.*

V. Course in building and architecture.

Architectural design.—Exercises in composition; history of architecture; the other arts of design. *Professional practice.*—Specifications; contracts; estimating and measuring; superintendence. *Drawing.*—Architecture, landscape, and the human figure; lithography and etching; modeling; drawing from memory. *Engineering.*—Structures of wood, stone, and iron: Foundations, walls, arches, domes, beams, trusses, girders, roofs. *Descriptive geometry.*—Applications to masonry and carpentry. *Warming, lighting, ventilating, acoustics.*—Lectures. *Building materials.*—Stones, bricks, mortars, and cements. *Political economy.* *Natural history.*—Zoölogy and physiology. *French,* (or Italian.) *German.*

VI. Course in science and literature.

The higher mathematics. *Chemistry.*—Special researches. *Physics.*—Special researches. *Architectural design.*—Exercises in composition; history of architecture; the other arts of design.

The foregoing studies are elective; the following studies are required:

Mental science. *Building materials.*—Stones, bricks, mortars, and cements. *Drawing.*—Subjects determined by each student's choice of studies. *Political economy.* *Natural history.*—Zoölogy and physiology. *French*, (or Italian.) *German.*

The officers of instruction are as follows:

William B. Rogers, LL. D., president; John D. Runkle, A. M., Ph. D., president *pro tempore*, and Walker professor of mathematics and mechanics; William B. Rogers, LL. D., professor of geology; Frank H. Storer, S. B., professor of general and analytical chemistry; John M. Ordway, A. M., professor of metallurgy and industrial chemistry; Cyrus M. Warren, S. B., professor of organic chemistry; William P. Atkinson, A. M., professor of English language and literature; Ferdinand Bôcher, professor of modern languages; John B. Henck, A. M., Hayward professor of civil and topographical engineering; William Watson, Ph. D., professor of descriptive geometry and mechanical engineering; William R. Ware, S. B., professor of architecture; George A. Osborne, S. B., professor of astronomy and navigation; Alfred P. Rockwell, A. M., professor of mining engineering; Edward C. Pickering, S. B., Thayer professor of physics; Samuel Kneeland, A. M., M. D., professor of zoölogy and physiology; Henry L. Whiting, United States Coast Survey, professor of topography; Henry Mitchell, A. M., United States Coast Survey, professor of physical hydrography; John Trowbridge, S. B., assistant professor of physics and superintendent of drawing; John A. Whipple, instructor in photography; Ernst Schubert, instructor in free-hand and machine drawing; Albert F. Hall, graduate of the institute, instructor in mechanical and plan-drawing; Robert H. Richards, graduate of the institute, instructor in assaying and qualitative analysis; William R. Nichols, graduate of the institute, instructor in determinative mineralogy and general chemistry; Francis W. Chandler, assistant in architecture; J. Nöroth, assistant in German; Hobart Moore, instructor in military tactics; George A. Osborne, secretary of the faculty.

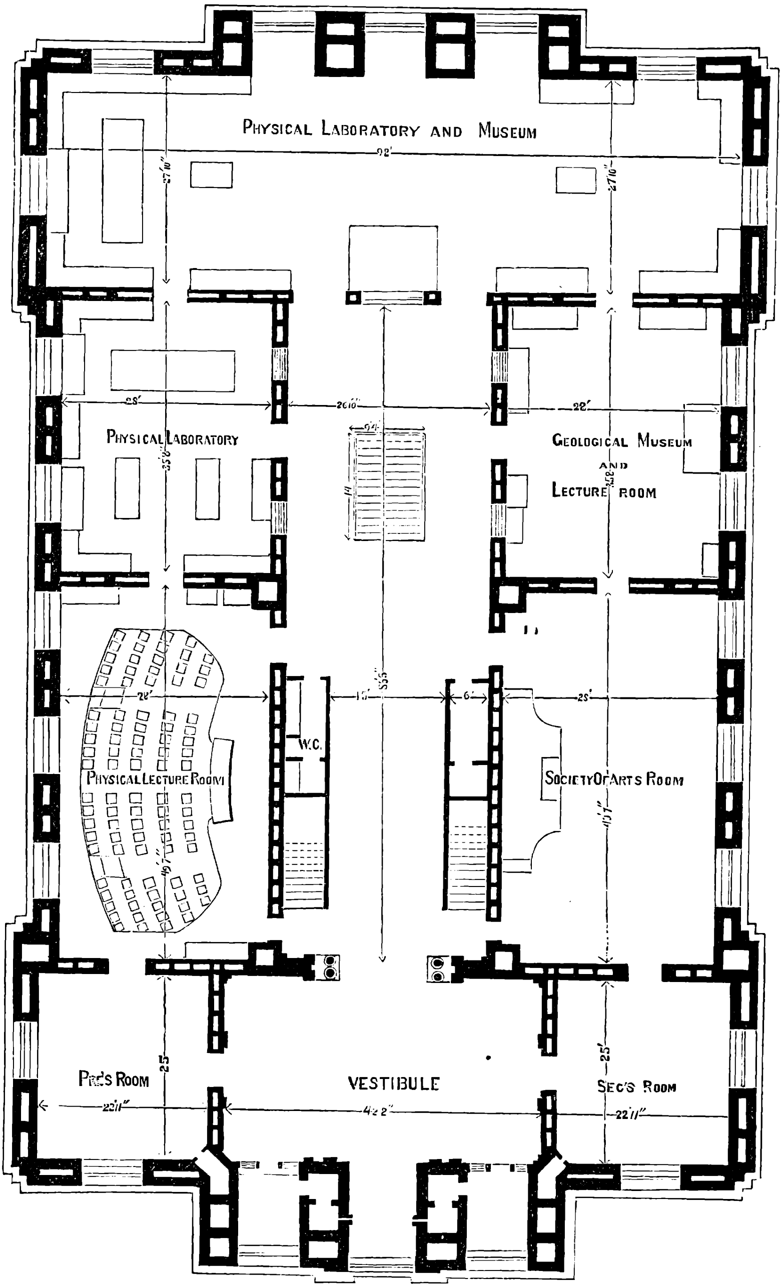
The degrees or diplomas corresponding to the leading departments of the school are as follows: 1. A degree in mechanical engineering; 2. In civil and topographical engineering; 3. In chemistry; 4. In geology and mining engineering; 5. In building and architecture; 6. In science and literature.

Evening courses of instruction are given to persons of either sex who are prevented from availing themselves of scientific instruction during the day, but are desirous of pursuing such studies in a systematic way, by the aid of afternoon or evening lessons and lectures. It will embrace a number of distinct courses, more or less varied from year to year by the omission or interchange of particular subjects, but including, in their entire scope, instruction in mathematics, physics, chemistry, geology, natural history, the English and other modern languages and literatures, navigation and nautical astronomy, architecture, and engineering.

The trustee of the Lowell Institute has established, under the supervision of the Institute of Technology, courses of instruction open to students of either sex, free of charge.

The conditions of attendance on these gratuitous courses are as follows: 1. Candidates must have attained the age of eighteen years. 2. Their applications must be made in writing, addressed to the secretary of the faculty, specifying the course or courses they desire to attend, mentioning their present or prospective occupations, and, where the course

PLATE XXXIX.



FIRST STORY

Scale 1/8 in. = 1 ft.

INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

is of a nature demanding preparation, stating the extent of their preliminary training. 3. The number of students in each class is necessarily limited. The selection will be made under the direction of the faculty. 4. It is expected that all persons attending these courses will cheerfully comply with the regulations prescribed for the class or lecture room.

THE BUILDING OF THE INSTITUTE.

The building of the institute is located on Boylston street, between Berkley and Clarendon streets, on a square given by the State to the institute and the Boston Society of Natural History. This square is the second one from the public garden. The building is 150 feet by 100 feet on the ground, and 85 feet high. It stands upon about 1,500 spruce piles, twenty-four feet in length, driven to a firm bearing upon the solid clay. The underpinning is of black granite, laid in cement mortar. Above the level of the ground rises a rusticated basement of Rockport granite, crowned by a deep scotia belt, upon which commences the superstructure of Connecticut free-stone and pressed brick.

The first story has a massive arched fenestration, and forms a base, surmounted by a moulded string-course, and a blocking-course, upon which rests the principal order of Corinthian pilasters, on the frieze of the entablature of which are chiseled, in raised stone characters, the names Archimedes, Newton, Lavoisier, Franklin, Bowditch, and others known to science. Each lateral elevation shows a recessed bay containing five windows, the pavilion at either end having the ornamental windows of the second story surmounted by oval lunettes. A balustrading above the enriched cornice crowns the whole.

The building is approached by a fine flight of granite steps about forty feet in width, from which, by a deeply recessed door-way and vestibule, access is gained to the Ionic entrance hall.

Rusticated free-stone piers support a tetrastyle portico, on a level with the second floor, which supports a richly-wrought entablature, crowned by a pediment, designed to contain an allegorical bas-relief, representing the Genius of Art bestowing her favors upon inventors and mechanics, who are in the act of presenting the results of their skill for her consideration. This pediment is surmounted by a stone pedestal, intended for the support of a colossal statue of Minerva, as patroness of art, and typical of the purposes of the institute. The architect is William G. Preston, of Boston.

1. *The basement floor.*—This floor is devoted to chemistry and its various applications. The central hall contains a chemical supply room, a clothes room, and a broad flight of stairs leading to the floor above. Under these stairs are water-closets and urinals. Directly under the entrance hall, on the floor above, are the boiler, engine, ventilating fans, and space for the storage of coal. Beginning now at the southwest corner on Boylston street, we find a private laboratory, complete in itself, for the use of the professors and such advanced students as are able to assist or to undertake investigations on their own account. From this we pass into the laboratory of general and qualitative chemistry. This room contains tables for fifty-two students, each table being supplied with a sink, gas, water, and a double set of drawers and cupboards for apparatus; thus affording accommodations, in two sections, for a class of one hundred and four students. This room is also supplied with small portable apparatus boxes, by means of which its capacity may again be doubled.

Adjoining this is the quantitative laboratory, furnished in a manner similar to the qualitative room, with such additional appliances as the

nature of the work demands. From this we enter the weighing room, the blow-pipe room, for the study of determinative mineralogy, and the chemical store-room. Crossing the hall we come to the carpenter's shop, and then to the metallurgical laboratory. This room contains a Griffin's gas furnace, a small reverberatory furnace for roasting ores, three furnaces for crucible operations, a kettle for sand-bath or for melting the more fusible metals, a small forge, a screw press, two cupelling furnaces, a bench for combustions, and bins for wood, coke, charcoal, anthracite, and bituminous coal. The floor of this room is laid with brick. We next come to the chemical lecture room, which will seat about one hundred and fifty. The floor of this room is so curved that each row of seats is on the same level, and sufficiently elevated above the row in front of it to make each seat equally available for the purpose of seeing. Connected with this is the assistant's laboratory, or lecture room, in which all the preparations for the lectures are made. The rooms on this floor are 12 feet high.

2. *Floor of first story.*—From the entrance hall on this floor, we pass into the president's office on the left, and the secretary's office on the right. From the president's office we enter the physical lecture room. The seats in this room are arranged in substantially the same manner as the chemical lecture room already described. Adjoining is a physical laboratory through which we pass into a second room devoted to the same purpose. The walls of these rooms are cased for apparatus, and tables for laboratory work, properly supplied with water and gas, occupy the central portions of the rooms.

The remaining rooms of this floor are the geological museum, in which the lectures on geology and mining engineering are also given; and the society of arts room. The rooms of this story are $16\frac{1}{2}$ feet high.

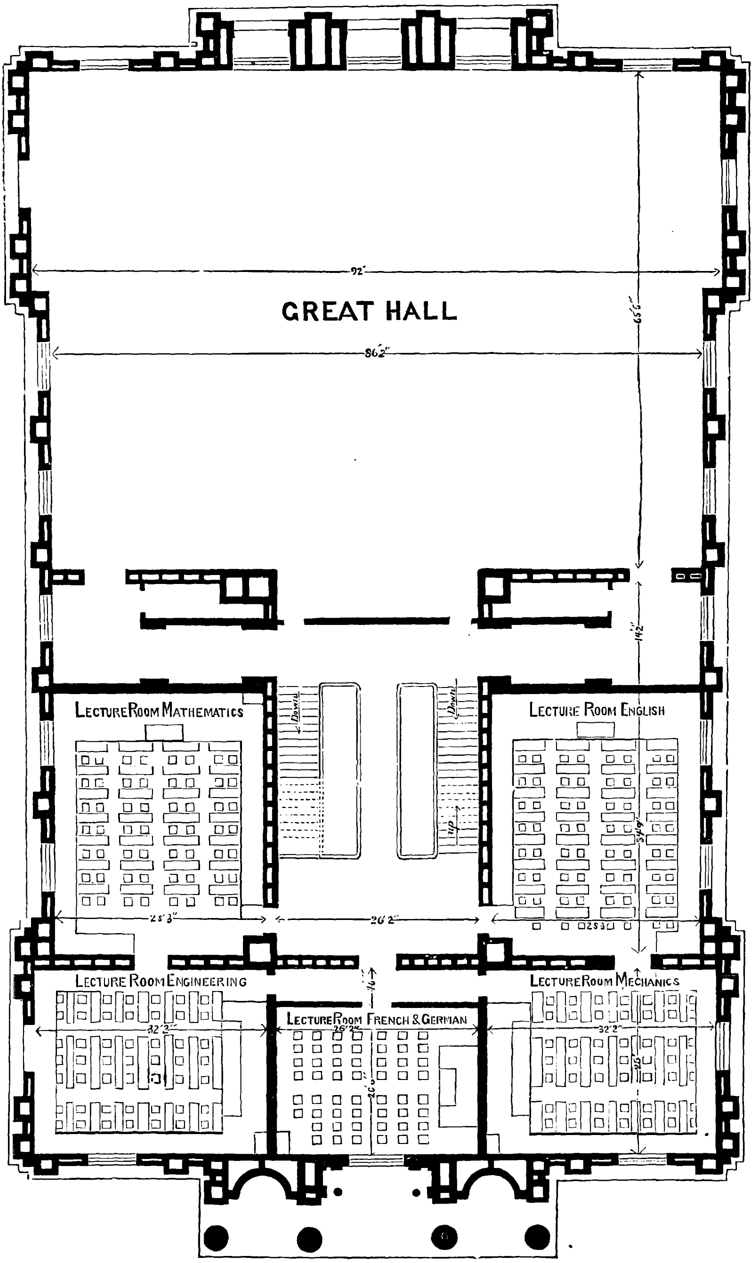
3. *Floor of the second story.*—The Boylston street end of this floor is divided into five lecture, or recitation, rooms, mainly devoted to the mathematics, civil and mechanical engineering, English and other modern languages, astronomy, history, &c. The northerly, or Newbury street, end of the floor contains the great lecture hall, 92 by $65\frac{5}{12}$ feet, and 27 feet in height. The five lecture rooms on this floor are $15\frac{3}{4}$ feet in height.

4. *Floor of the half story.*—There are five rooms on this floor 10 feet high, corresponding to the five on the floor below. Three of these rooms are devoted to the architectural museum; the fourth is a modeling room in which students in the architectural and the engineering department are required to model, in plaster, designs and constructions in their professional work; and the fifth a museum and lecture room in natural history.

5. *Floor of the third story.*—The five outer sky-lighted rooms of this floor are occupied by the drawing department, and the sixth room, over the central portion of the great lecture hall, is devoted to the museum of descriptive geometry and mechanics. The height of these rooms is $12\frac{3}{4}$ feet.

6. *The floor of the fourth, or lantern, story.*—This floor is $43\frac{3}{8}$ feet wide, and 11 feet in the clear. The front end contains six studies of professors; the rear end is divided into two long rooms each $65\frac{5}{12}$ by $21\frac{5}{6}$ feet, well lighted on the sides, sky-lighted in the center, and well adapted to drawing, or any work requiring the best light. The interior of the building is entirely finished, with the exception of the great hall, which it is the intention of the institute soon to complete. With a narrow gallery on two or three sides, this hall will seat 1,200 to 1,500 persons.

PLATE XL.

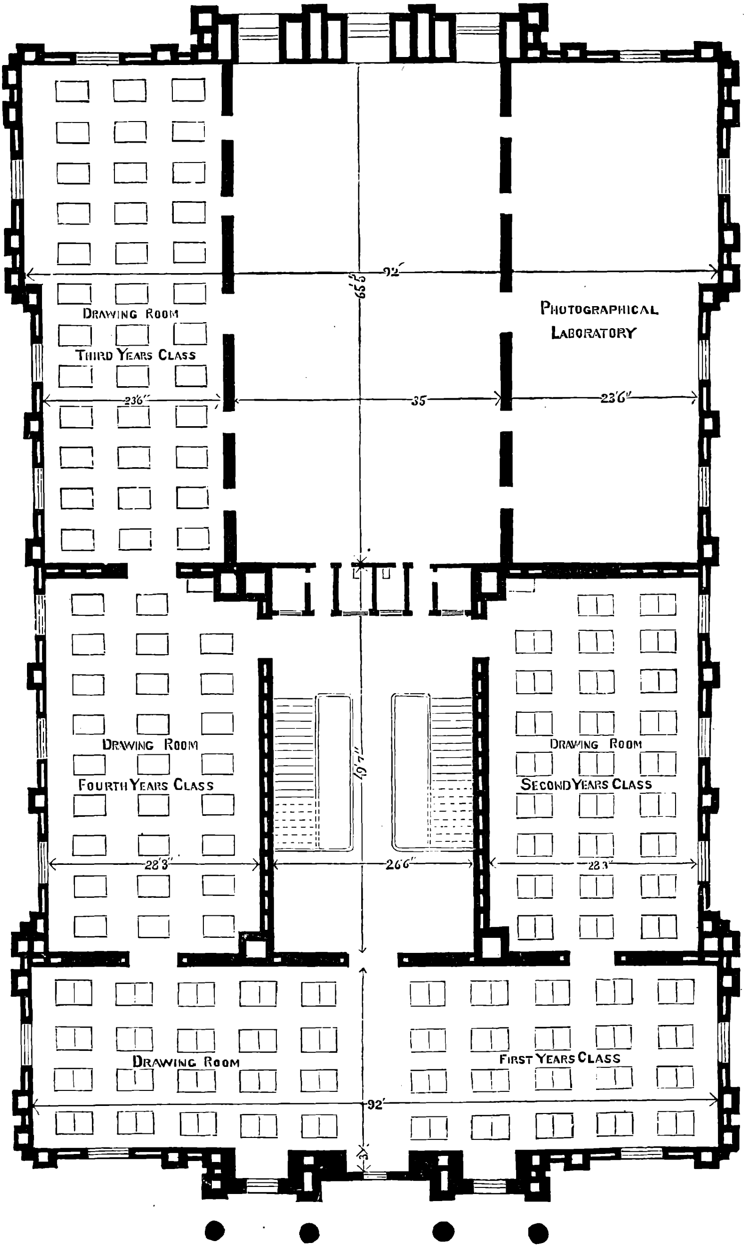


SECOND STORY

Scale 1/8 in = 1 ft.

INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

PLATE XLI.



THIRD STORY
Scale ⅛ in=1 ft.

INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

On the top of a 20-inch cross-section wall, extending from foundation to roof, is erected an observatory from which a large number of coast survey stations are visible, which are used in the instruction in triangulation and geodesy.

A second building is yet to be built for the museum of the institute

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THE BOOKS OF THE YEAR.

It is not intended to furnish a criticism of current agricultural literature to show its errors, teachings of doubtful utility, or other shortcomings; it is still further from the design of this paper to give a blind or a servile commendation of new books; but it is deemed eminently proper to give to the millions of readers of the Report of Agriculture an idea of the progress of American agricultural literature. Formerly the agricultural books published in this country were either foreign or an adaptation of European publications to the supposed wants of this country. Our agricultural authors are now offering works of greater originality, and better adapted to the requirements of our soil, climate, and modes and appliances of culture.

It is the aim of this review to give the general scope and tenor of the work examined, present a glimpse of its characteristic features, make an illustrative citation, and thus afford the means of judging of its practical character and tendency. It is at least important that all portions of the country to which this volume penetrates should be furnished with a complete list of the publications of the year, with some idea of their contents; and publishers of new books are respectfully requested to make a prompt notification of their issues, that no omissions may occur in the annual review.

PEAR CULTURE FOR PROFIT. By P. T. Quinn, practical horticulturist. 18°. 136 pages. New York: The Tribune Association. 1869.

Considering the immense number of pear trees that have been sold the last twenty years, and the excellent varieties of fruit that have been brought into notice, of both native and foreign origin, it is surprising how few really fine, healthy, vigorous pear orchards can be found in any part of the country. On the contrary, feeble, misshapen, unproductive trees are to be seen in all localities; and Mr. Quinn thinks that where one has made the culture of this fruit profitable, five can be found who have utterly failed in it. To remedy this evil, and to furnish intelligent directions for raising pears, he has written this work, which is based on the results of his own successful experience of more than a dozen years. The art of growing trees that will produce choice fruit he considers very simple when once understood. Too many have thought that a pear tree once in place would take care of itself without further care. Sufficient regard has not been paid to the importance of the aspect of the orchard, the habits of the trees, or the composition of the soil.

The most suitable situation for a pear orchard is one with a north-eastern aspect, on rising ground where but little is to be apprehended from late frosts while the pear is in blossom. Mulching with salt hay, straw, long manure, or other litter in the fall is recommended to retard the swelling of the buds and to prevent alternate freezing and thawing. When exposed to high winds it is well to shelter orchards with belts of

evergreens of rapid growth. A heavy soil, or one that is sandy, with a retentive subsoil, is unsuitable, without underdraining, for pear culture. Different modes of draining are given.

After an experience of fourteen years Mr. Quinn concludes that, with a single exception, the culture of dwarf pears in an orchard is a failure. The exception is the Duchesse d'Angoulême on a quince stock. This variety often becomes a standard by pushing out roots from the pear stocks; but on quince roots it is more productive and profitable than when planted on pear roots. One-year-old trees, low-trained and stocky, are preferred to old and spindling ones; and none should ever be purchased from irresponsible tree peddlers.

On the question, whether spring or autumn is preferable for transplanting trees, there has been a diversity of opinion among cultivators In Mr. Quinn's pear orchards of several thousand trees, about one-half were set out in the fall and the other in the spring, and, except in a few cases, with but little noticeable difference. More depends on the condition of the tree and the thorough preparation of the soil than on the time of planting. Fall planting has this advantage, that persons are not then so much hurried with other work as in the spring, and the planting is more carefully done. A large subsoil plow should be run several times through the ground where the trees are to be planted, until the soil for two or three yards on either side of the center line is completely pulverized, which will leave it in fine condition for the roots to penetrate, lessening the expense of making holes and leaving but little to be done with the spade. The roots must be carefully drawn out at right angles with the body of the tree, all bruised or broken ones having been previously cut off with a sharp knife.

In making a selection of varieties to plant, Mr. Quinn advises that it be confined to five or six well-known sorts, instead of trying the numerous kinds on nurserymen's catalogues, and says, if he had confined his selection at the start to five instead of fifty varieties, he should be several thousand dollars better off. In an orchard of five hundred trees he would plant not less than one hundred of the same kind. Of course no one list will answer for all parts of the country; but for the New York market, after an experience of fifteen years, he has reduced his original assortment of fifty varieties to the eight following, viz: the Bartlett and Doyenné Boussock for summer; the Duchesse d'Angoulême, Beurré Clairgeau, and Seckel for autumn; and the Beurré d'Anjou, Lawrence, and Vicar of Winkfield for winter; all standards, except the Duchesse d'Angoulême.

The best form for pruning pear trees is the pyramidal or conical, as it brings the largest surface of limbs nearest the ground, the tree suffers less from heavy winds, the trunk is less exposed to the direct rays of the sun, fruit-spurs are formed on the main branches near the body of the tree, which thus sustains more weight with less injury, and the fruit can be easily thinned and gathered. Some varieties naturally take the pyramidal form. One year from the time of budding, the young tree consists of a single upright shoot, with the largest buds at the top; one-half of this growth should be cut off, which will develop numerous side branches. To encourage the growth of wood and build up the tree, the general pruning should be done in March and April.

To change the habits of the tree from wood-making to fruit-making, select young shoots, tie them in a loose knot, bending them into the form of a bow or ring, as is sometimes done with grape vines, and fruit-spurs will certainly appear within two years. The *rationale* of this seems to be that whatever tends to cause a rapid diffusion of the sap

and secretions of any plant causes also the formation of leaf-buds instead of flower-buds; and, on the contrary, whatever tends to cause an accumulation of sap and secretions has the effect of producing flower or fruit buds in abundance; so that a flower-bud is only a contracted branch. By thus arresting the motions of the fluids and secretions in a tree we promote the production of flower and fruit-buds. This is an important fact. Pear trees in some cases are wholly barren of fruit for a dozen years, though they appear to be vigorous and perfectly healthy.

Unfermented manures should never be used in the holes or around pear trees when planted. Chemical analysis of the pear tree shows that barn-yard manure, composted with muck and the salt and lime mixture, is valuable in producing both fruit and wood. Professor Mapes applied 400 to 600 pounds superphosphate of lime, mixed with twice its bulk of earth, as a top-dressing harrowed in and around the trees, with great success, having fine healthy trees and abundant crops. Mulching with charcoal dust, or coarse meadow or salt hay, promotes the growth of both wood and fruit. Salt hay also keeps the surface moist and prevents the growth of weeds.

Valuable suggestions are given in regard to picking, handling, sorting, and packing the fruit, upon which, after all, success in fruit culture depends. By carefulness in these particulars the fruit sells for double the price it otherwise would command. New half-barrels are recommended for choice fruit, which thus commands a higher price for hotel-keepers and fancy fruit-dealers. It is poor economy to save ten cents in buying a soiled second-hand flour barrel when new ones can be had.

The book concludes with a plan of an orchard-record, and directions for propagating, budding, and grafting, with practical hints on the general management of pear trees in regard to blight, insects, curculio, &c.

THE GREEN-HOUSE AS A WINTER GARDEN: A manual for the amateur; with a list of suitable plants and their mode of culture. By F. E. Field. With a preface by W. C. Bryant. 16°. 86 pages. New York: G. P. Putnam & Son. 1869.

The increasing taste for flowers, and the improved and cheaper methods of constructing green-houses, have led to a large increase in their number within a few years. The little practical hand-book of Mr. Field is admirably adapted to those whose means or whose desires lead them to content themselves with a green-house on a small scale, to which they can give their personal attention. Mr. Bryant introduces the author to American readers as a friend who owned a small green-house in England, which he managed with such ingenuity and success, without encroaching on his regular business pursuits, as to take an unusually large proportion of the prizes at the horticultural exhibitions of his neighborhood.

Without pretensions to the elaborate character requisite for professional gardeners having charge of spacious conservatories, this little work embraces all the information necessary to the amateur cultivator. In the space of less than eighty pages it discusses the proper aspect and construction of a green-house and its general arrangement, the diseases of plants, a list of the most desirable annual, herbaceous, and bulbous-rooted plants for an amateur's attention, suitable composts, the best methods of striking cuttings, &c. The work is no abridgment of any larger one, but gives the results of the author's own successful experience, and shows how all who have a love for the cultivation of exotic plants can indulge their taste at a moderate expense, and by the simplest and most economical methods.

The proper exposition for a green-house is a little east of south, the morning sun being more desirable than the afternoon, and the greatest

amount of sunshine possible must be secured. The simplest form of the house is the lean-to, without side-lights, in which many flowers can be successfully grown; an oblong is better than a square shape, as more convenient for reaching and arranging plants; a structure of wood is preferable to one of iron. It should be kept as low as possible, as everything thrives better near the glass. A good ventilation from back to front, over the tops of plants, is important. The glass, if large panes are used, will require but few laps, and these must not exceed one-eighth of an inch, lest the moisture which lodges in them should break the glass in frosty weather. The proper slope of the roof is an angle of about 45°, which affords the greatest amount of sunshine when most needed. Heating by hot water is undoubtedly the best mode, but it requires an extensive apparatus, and is not considered economical in the matter of fuel.

The basis of the soil for all plants, excepting those requiring pure peat, is a hazel-colored loam, the top-spit of good turf land, well filled with fibrous roots, which should be laid in a heap. It is fit for use as soon as the grass is dead, the roots remaining in the shape of fiber. Horse or cow dung, thoroughly rotted down till it becomes a black friable mold, will also be needed. Charcoal, broken to the size of a pea, is advantageously used in the compost for almost all plants. English gardeners think it adds richness to the colors of flowers, and it is surprising how the roots will cling to it. For striking cuttings, clean, sharp, light-colored sand is necessary.

Directions for the general management of a green-house, in all its details, are given; and the list of the most desirable plants, thirty or forty in number, for an amateur to cultivate, is quite useful to beginners.

RESOURCES OF THE SOUTHERN FIELDS AND FORESTS, MEDICAL, ECONOMICAL, AND AGRICULTURAL; being also a medical botany of the Southern States; with practical information on the useful properties of the trees, plants, and shrubs. By Francis Peyre Porcher, M. D. Charleston, S. C.: Walker, Evans & Cogswell. 8°. 733 pages.

Dr. Porcher was formerly a surgeon in charge of the city hospitals of Charleston, and during the late war was directed to prepare a book on the medical plants of the South, as expedients, for the information of the physicians and surgeons of the confederate army, while suffering from the pressure of war and the blockade. This work is a new edition, revised and largely augmented, giving an exhaustive view of the resources of the southern fields and forests, with reference to their purposes of utility, medicine, arts, sciences, and mechanics. It is not a strictly medical work, but contains also notices of the most important textile fibers, grains, fruits, oils, resins, grasses, materials for making paper, cordage, &c., to be found in the Southern States. The southern flora is extraordinarily rich. The teeming products of every variety of soil and climate, from Maryland to Florida, and from Tennessee to Texas; the Atlantic coasts, with their marine growth; the mountain ridges of the interior; the semi-tropical productions of Florida and Louisiana, with the rich alluvia of the river-courses, all contribute to swell the lists and produce a wonderful exuberance of vegetation. These States occupy almost the whole of the temperate zone in the Western hemisphere. With a genial sun, enduring extremes of neither heat nor cold, they are rich in natural resources, and possess a variety of soil and a range of temperature affected by the presence of both sea and mountain. The author's "Sketch of the Medical Botany of South Carolina," published in 1849, embraces notices of 410 species, out of 3,500, possessed of medicinal or economic value, of which but a very few are exotic; and

in the present work, full descriptions are given of six to seven hundred plants peculiar to South Carolina that are useful in medicine and the arts.

Dr. Porcher urges the importance of draining the marshes and swamps of the South, particularly those near the cities and along the river-courses. In the exhaustion of this section produced by the rebellion, and the transition state of labor, this work cannot be done by the separate and isolated efforts of planters and farmers; but a general system of drainage should be undertaken as a public work by the State. Operations should be commenced on the inland swamps, each of which presents an independent problem to the civil engineer. Along the coast, at a distance of forty miles from the sea, there is a rise of about twenty feet above the general tide level, giving a fall of half a foot to the mile, which, the doctor asserts, from his own experience, is sufficient for thorough and perfect drainage. Alluding to the beneficial results that have followed the great draining operations in Holland, Belgium, and England, he adds that the French also have drained and reduced to successful cultivation large tracts of unhealthy regions in Algeria, which now produce all the semi-tropical fruits, grains, &c., in sufficient quantities beyond home consumption to ship largely to other countries. And in Italy the picturesque and fertile valley of the Chiana, smiling in peace and plenty, strewn with villas and farm-houses, and intersected by the best constructed roads always so indicative of wealth and abundance—a valley which now supplies all Tuscany with corn, wine, and oil—was once a pestilential and deserted region, and noted in the earliest times for its insalubrity. In this connection Dr. Porcher says:

> The simplest plan for draining the secondary or inland swamps is to run a straight central canal through them, which removes the obstructions caused by logs and mud flats, and takes off the main body of water. A canal or drain should also be made on each side, to receive the water coming in from surrounding high lands. The underground system of draining with tiles, generally practiced in England and on the continent, is applicable in this country only to a limited extent at present.
>
> The lands throughout a large portion of the South are quite rich enough for every purpose, and we need not go to the West or elsewhere in quest of better soil. Since emancipation, immigrants from Europe may be employed in these public works now proposed. The cutting down of trees, and exposing the surface to the almost constant action of the sun, will subject it to the important agency of evaporation. The removal of the causes of malaria will be the result; and if complete exemption of the sickly portions of the State from its baneful influences, and from periodical fevers, by which white labor is made possible, is not secured, yet the hygienic condition of the whole country will, at least, be improved, and the wealth and happiness of our citizens generally enormously increased.
>
> By draining our swamps, we secure a soil for corn, cane, &c., enriched by the vegetable matter accumulated for centuries, and the higher lands are released for cotton and other crops.
>
> Besides, when we drain the swamps, there ensues an interstitial drainage by a process of molecular absorption incessantly acting, which extends for miles around, affecting the high lands at a much greater distance than many would suppose, rendering them drier and allowing pines, oaks, and other plants to spring up where before only swamp trees and rank grasses grew.
>
> Islands and isolated sections of country favorably situated, as, for example, those adjoining Charleston, and embraced between the Cooper and Ashley Rivers, the same being true of those lying near other cities and along our coast, can be drained and made rich and habitable, even in the warm months. They will be occupied by garden farms, which will supply not only the cities contiguous to them, but fill our ships going north with fruits, vegetables, and produce.

The realization of so extensive a project is perhaps impossible at present; but viewed in every light as respects the common welfare, it involves considerations, the wisdom and policy of which will establish an honorable distinction to any administration that may adopt it.

AN ESSAY UPON THE CULTURE AND MANAGEMENT OF FOREST TREES AND NATIVE EVERGREENS; exhibiting the vast amount of timber being consumed here, the various profits and advantages of forest-tree culture, and directions for planting and cultivating the same. By Rev. George Pinney, Sturgeon Bay, Wisconsin. 8°. 51 pages. Galena, Illinois: D. W. Scott. 1869.

Mr. Pinney makes a plea in this little work in favor of setting out plantations of evergreens and forest trees, particularly on the western prairies and immense treeless regions opened by the Pacific railroad. He urges this from considerations of economy, in view of the rapid disappearance of our forests, occasioning the steadily advancing price of lumber; their influence as screens and wind-breaks in winter; their benefits to orchards and crops during the summer and growing season; their effect in producing a greater degree of atmospheric humidity, and consequently a more regular supply of rain, and in ameliorating sudden changes of atmosphere; and argues that the very make of our country demands extensive forest planting in the West. In support of these positions he gives, besides his own experience, a large array of facts bearing on the subject, from the best writers of the day on arboriculture.

The older States now draw large supplies of lumber from the West. Hundreds of millions of feet of pine are annually taken thousands of miles from the northern lakes and the head-waters of the Mississippi to the Atlantic and the Gulf States. Michigan, Indiana, and Wisconsin furnish black walnut and many other woods now used in the manufacture of cabinet ware, wagons, and machinery in the East. Oak and pine are shipped to Europe for the purposes of ship-building, and hundreds of thousands of feet of black walnut are shipped for gun-stocks alone. All this is in addition to the wants of the Prairie States, which, from their primitive barrenness of timber, exceed all other demands. Chicago alone receives and distributes annually one thousand million feet of lumber, five hundred and fifty million shingles, one hundred and fifty million laths, and so on. New York was formerly pre-eminent in the production of lumber, but her supply is rapidly diminishing; black walnut has almost wholly disappeared; the wild cherry and cucumber tree are great strangers; hard maple and hickory in some sections are nearly gone; while entire counties, formerly heavy with hemlock and pine, can with difficulty now and then supply a farmer with a knotty sill for a small barn. The new Adirondack railroad through the heavily wooded "John Brown" tract may arrest, temporarily, the deficiency of supply in that State. New railroads require an almost incredible amount of lumber, not only in their first construction, but in the continual replacement of old timbers and sleepers. All this is in addition to the vast number of acres cleared annually, and to the timber burned by farmers.

Palestine, Syria, Greece, and other parts of the Old World furnish numerous instances where the universal destruction of forests has converted vast tracts, once covered with luxuriant woods, verdant pastures, and fertile meadows, into arid sandy deserts, so far deteriorated as to be almost irreclaimable by man. In several countries in Europe governments have taken possession of the forests to insure their proper treatment and preservation.

Forests are useful as screens and wind-breaks in winter on large tracts of unbroken country, where cutting winds sweep fiercely, driving the snow into drifts, leaving the bare ground subject to the full action of the hardest frosts, throwing out young plants of winter grain, and injuriously affecting the health of man and of the shivering animals.

Orchards and crops are benefited during the summer and growing season by belts of forest trees. The destructive blighting of the apple orchards in Ohio is thought to result from the rapid drying of the absorbing currents of westerly winds, relieved of their humidity by the condensing power of the snow-capped rocky range, and consequent sudden depression of temperature. The apple orchards throughout Ohio do not now generally produce fine fruit, while thirty years ago, before the forests were so fully swept-away, a failure of a rich harvest of fine apples was almost unknown, and thousands of flat-boat loads were shipped to New Orleans. Dr. Petticolas, an intelligent pomologist of Ohio, stated, in 1864, that of one hundred and twenty to one hundred and thirty varieties of apples in bearing, it was difficult to select six kinds that were good and merchantable; the larger part were disfigured, scabby, and warty. Some kinds are even less prolific than they were fifteen or twenty years ago. Rambos, that at seven years old bore ten bushels of good fruit, now seldom bear over four or five even in the most favorable seasons. Redstreaks show a similar falling off, in quality and quantity. Trees of all ages are now proverbially unproductive. The White Bellflower and White Pearmain, formerly the best of Ohio apples, are now so knotty and disfigured with the scab as to be hardly worth gathering. No such change is noted in Western New York, where apples are as fair as they were thirty years ago. The forests there, though cleared in many places, have not been so indiscriminately destroyed as in Ohio. Fruit trees in cities, where protected by high brick blocks, it has long been noticed, ripen their fruit earlier and in greater perfection than where exposed to the high winds of an unprotected country.

Forests also tend to produce a greater degree of atmospheric humidity, and consequently a more regular supply of rain. All observers have noticed the diminution of water in our streams and ponds, as closely connected with the destruction of our forests. Thorough under-draining has, in a great measure, restored failing springs. The rapid evaporation from the surface, by the action of unbroken, drying winds, has been checked by facilitating the gradual descent and withdrawal of water from below.

Extensive forest planting seems to be required in the West, as an entire absence of moisture characterizes the prevailing winds through nearly all the vast regions west of Kansas. This dryness of the atmosphere results from the fact that there is no large body of water in the central part of the North American Continent, west of the Mississippi, sufficient to exert any controlling influence upon the temperature of all that region. Five degrees north from Fort Leavenworth we are in a cold and frozen climate, closed early in the fall and locked in frost till late in the spring. Five degrees south we have almost forsaken the region where ice may be said to form. In view of these facts Mr. Pinney says:

> This middle ground is wholly controlled by the prevailing type of the season, interspersed with the sudden and often violent interjection of short periods of temperature from the opposite points of the compass. Thus, the general winter may be mild without snow, with scarcely frost enough to prevent plowing a single week through the entire winter; and then may come one, two, or five days when the thermometer will stand anywhere from zero to 26° below zero. On the other hand, in a long, cold, snowy winter, a period of very early spring or summer, as regards its balminess and comfort, may break in with equal suddenness. The same latitude, upon either the Atlantic or Pacific coast, is no criterion by which to judge of the temperature of the plains. The presence of a great ocean, with its broad, open bosom continually exposing to the biting air the fresh warm currents of her inmost being, gives a stability and produces a control over the temperature which is unknown when we reach a point almost two thousand miles from each ocean, and one thousand from the Gulf of

Mexico. No portion of the world more needs the presence of great and numerous forests to preserve an equilibrium of temperature than the central parts of North America, and especially upon this latitude, which, as it approaches either ocean, is so admirable and so much sought for.

In the directions for propagating and transplanting forest trees, both from seeds and cuttings, describing the soils best adapted to the different kinds of trees, Mr. Pinney states that, of the kinds which thrive best in wet soils, the larch, birch, balsam fir, spruce, and arborvitæ will grow rapidly from the seed, especially the larch, which will make four to eight feet growth annually, on rich swamp lands. There are thousands of acres of such lands now entirely valueless, which, if planted with larch and spruce, would soon yield a rich income to the owners.

Mr. Pinney's sixth chapter is mainly condensed from Mr. Lapham's report to the Wisconsin legislature, and gives the special characteristics and value of some leading varieties of forest trees, as the rock elm, sugar maple, cedar, pine, and larch, the latter being one of the most durable of trees, excelling even cedar for fence posts, if the sap wood is hewed from the portion set in the ground, and is far superior for holding nails. He concludes his treatise as follows:

The evergreen forests of Wisconsin have been, and still are, more valuable than placers of gold in the Rocky Mountains, if we simply count the dollars which the lumbermen have extracted from them by the aid of toil and machinery. Great forests have been robbed of their best trees for the sake of a single log, or a few shingle-bolts; other forests have been wantonly destroyed. The young trees, designed by Providence to replace the old, have been ruthlessly cut away to make a place for an experiment in growing corn on sands so destitute of vegetable matter that it could not grow until the pines had for ages more shed their needle-shaped leaves on the barren surface.

The time has already arrived when we begin to feel that there is a scarcity of pine timber. Where it was but a few years ago sold for $10 per thousand feet, it now readily brings thrice its former price, with no prospect of being cheaper. This increase is not owing to a scarcity of labor, as some tell us, nor to an increase of currency, as others say. Although these causes may have some effect at present, yet it is mainly owing to the difficulty of procuring the trees from which lumber is made that has raised the price. In a few years more, if lumber continues to advance—and there is no reason why it should not—it will be beyond the reach of the poor, or even the middle classes, and these must resort to other materials with which to construct their abodes; and, as in Europe, with no intermediate material between mud and stone-walls, the rich will live in this, the poor in that.

FARMING FOR BOYS: What they have done, and what others may do, in the cultivation of farm and garden; how to begin; how to proceed, and what to aim at. By the author of Ten Acres Enough. With illustrations. 16°. 286 pages. 1869. Boston: Ticknor & Fields.

This book is written to show boys who are selecting a profession for life the superior charm, as well as the generally superior safety, of a farmer's life. The common tendency of farmers' sons has been to set their faces toward the cities, allured by the occasional instances of eminent success that have been witnessed in such men as Peabody, Lawrence, Stewart, and others, forgetting that in the lottery of commerce there are innumerable blanks to every prize. The charm of city life has been unduly magnified, while the greater one of country life has been overlooked.

The work under notice is an effort in an entirely new field in agricultural literature. In times past the boys upon the farm have been too generally overlooked, and too little effort has been made to render rural homes and agricultural employment attractive to them. The author assumes that this neglect is the prominent reason why so many of our boys abandon the rural scenes of their childhood, and seek for amusement and profit in the dangers and uncertainties of city life. He argues strongly for the superior safety and comfort of farming, where, if men

do not become suddenly rich, they seldom become suddenly poor. Striking instances are given of the general superiority of agricultural employments, of their comparative freedom from temptation to vice, and of the sure rewards they bring to intelligently directed industry.

To stimulate the faculty or disposition for acquiring money, the author has endeavored to show how the boy upon a farm may make a beginning:

> Heretofore the children of too many farmers have been kept as mere drudges, now at school and now at work, with no pains taken to encourage their individual enterprise by showing them how to make something for themselves. The hope of profit nerves the enterprise and sharpens the wit of men. Why should our boys be so wholly excluded from all share in what, when they have grown to manhood, so generally becomes the great impulse to all future effort?

The general argument of the book is set forth in a lively narrative, abounding in practical incidents to enforce the positions assumed; and though written for the boys only, it contains hints and information which even adults may study with profit. It is got up in an attractive style, and the incidents of the story are illustrated with fine engravings.

THE NEW AMERICAN FARM BOOK. Originally by R. L. Allen, author of Diseases of Domestic Animals, and formerly editor of the American Agriculturist. Revised and enlarged by Lewis F. Allen, author of American Cattle, editor of the American Short-horn Herd Book, &c. 12°. 526 pages. New York. Orange Judd & Co.: 1869.

This is a revised and enlarged edition of the work of Richard L. Allen, originally published in 1846, the first and only comprehensive treatise of the kind published in this country. It was filled with valuable matter, partly original and partly compiled from the publications of the day, brought into available shape through the tact and industry of its experienced author. In this progressive age, however, improvements so vast have been made in practical science, particularly in agriculture, during the last twenty years, that a revised and enlarged edition has become necessary to meet the popular demand on most of the subjects discussed. This has been accomplished by Lewis F. Allen, who has added new discoveries and subjects not before well comprehended, enlarging the work so as to embrace the progressive improvements in agriculture down to the present day. It discusses the classification, management, and properties of soils, organic and inorganic manures, irrigation and draining, the grasses, grains, roots, leguminous plants, fruits, and miscellaneous objects of cultivation aside from the ordinary farm crops; also, farm buildings, domestic animals, poultry, bees, diseases of animals, &c. Abstracts of a few chapters are subjoined as specimens of the manner in which the facts and arguments of the book are presented.

Wood ashes are recommended as the best of the saline manures and the most economical, being produced by every household. Not a pound should be wasted, but all saved and applied to the land, at the rate of twelve to fifteen bushels per acre on light soils, and twice that amount on rich lands or heavy clays. Potatoes, turnips, and all roots, as well as lucerne, clover, peas, beans, and grasses, are great exhausters of the salts, and are consequently benefited by ashes. They are used with great advantage for these crops in connection with bone-dust or gypsum. Leached ashes, though less valuable, contain all the elements of the unleached, having lost only a part of their potash and soda. They may be drilled into the soil with roots and grain, sown broadcast on meadows or pastures, or mixed with the muck heap. The ashes of bituminous coal, though greatly inferior to those of wood, may be of some value applied in a similar manner.

Next to ashes, lime has been instrumental in the improvement of our

soil beyond any other saline manures. It makes heavy land lighter, and light land heavier; gives adhesiveness to creeping sands or leachy gravel, and comparative openness and porosity to tenacious clays, and has a beneficial effect in disinfecting the atmosphere of noxious vapors. It does not condense and retain the organic matters brought into contact with it by the air and rains, but it has the better effect of converting the insoluble matters in the soil into available food for plants. In drying the land and accelerating the growth of vegetables, the judicious use of lime is equivalent to an increase of temperature. Its influence in resuscitating exhausted soils is striking, and whenever procurable at low prices, it is one of the most economical and efficient agents in securing fertility. Large crops only are profitable. The market value of indifferent ones will seldom meet the expense of cultivation, and it is only the excess beyond this which is profit. If fifteen bushels per acre of wheat are an average crop, and it requires twelve bushels to pay all expenses of production, three bushels are the amount of profit. If by the use of lime and ordinary manures the product can be raised to thirty bushels per acre, the profit would be near the value of twelve or fifteen bushels, after paying for the manures. Thus the advantage from good management may be five times that of neglect. This is stated as illustrating a principle, and not as an exact measure of the difference between limed and unlimed land. Large farms, worn out and worthless from long cropping, have been restored to more than their virgin fertility by the liberal application of lime. It may be applied in various ways: placed, immediately after burning, in small heaps, and left to slack by rains and the air, or mixed with water and sprinkled over the surface; or, if a small quantity only is wanted, add it to the compost heap when thoroughly air-slacked, covering the heap with a coating of earth to arrest and retain the ammonia that its avidity for acids expels rapidly. As fresh-burnt lime does not act on crops the first year, it should be incorporated with three or four times its bulk of earth, and then spread directly on the surface of the ground. To give lime its fullest effect, it should be kept as near the surface as possible; spread it after plowing, taking care to harrow it in well. Its weight and fineness give it a tendency to sink, and, after a few years' cultivation, much of it gets below the proper depth for its efficient action. This gives additional value to underdraining and subsoil plowing, which enable the atmosphere and roots to follow it, thus prolonging its effects, and augmenting the value of the crops.

Among the inorganic manures, charcoal holds a high rank. Powdered and scattered over the ground, it absorbs and condenses the nutritive gases within its pores to the amount of twenty to eighty times its bulk, continually gleaning these floating materials from the air, and storing them as food for plants. Charcoal, as well as lime, often checks rust in wheat and mildew in other crops; and in all cases mitigates their ravages where it does not wholly prevent them.

In the fermentation of organic manures, all the vegetable and liquid fertilizers about the premises should be utilized, as urine, brine, soapsuds, ashes, gypsum, and coal dust, the last three combining with the ammonia as it is formed. The heaps should be covered with a coating of turf, peat, or fine mold, to absorb what gases might escape the gypsum, &c. Old mortar and effete lime may also be added for the formation of nitric acid, which it draws from the materials in the heap, as well as from the nitrogen of the air. The curious fact is mentioned that the Chinese, who utilize every spoonful of manurial element, are so well aware of the large absorption of niter by lime in a course of

years, that, to secure it, they will gratuitously remove the old plaster from walls and replace it with new.

In speaking of liquid manures, it is stated that the urine of a single cow is considered in Flanders, where agriculture has reached a high state of improvement, to be worth $10 per year. It furnishes nine hundred pounds of solid matter, and at the rate of fifty dollars a ton, for which guano is frequently sold, the urine of one cow is worth $20; yet how many farmers waste urine and buy guano. Dr. Dana says: "The urine of a cow for a year will manure one and a quarter acre of land, and is more valuable than her dung, in the ratio, by bulk, of seven to six; and in real value as two to one." How important, then, that every particle of it be husbanded for the crops. There is much difference in the value of the manure of animals, its richness depending upon the quality of their food. Animals kept on a scanty supply of straw or refuse hay yield manure but little better than good turf, and far inferior to the droppings of such as are highly fed. In a long series of careful experiments made at Dresden and Berlin, by order of the Saxon and Prussian governments, it was ascertained that soil which would yield three for one sown, when dressed with cow dung gave seven, with horse dung, ten, and with human, fourteen.

Manuring with green crops has been extensively adopted in the older settled portions of the United States. The high price of labor and consequent expense of making artificial manures render this plan economical. It fertilizes the land and clears it from noxious weeds, by plowing in the vegetation before the seeds are ripened, besides loosening the soil, and placing it in the mellowest condition for the crops that are to succeed. Its results have been entirely successful when steadily pursued, and lands worn out by improvident cultivation, and unsalable at $10 per acre have, by this treatment, been brought up in value to $50. The full benefits of green crops seem to be realized only on soils that have a large proportion of lime. Buckwheat, rye, peas, &c., have been used for plowing in, but nothing thus far tried is so well fitted for the object as red clover, which is suited to all soils that will grow anything profitably, from sand, if possessing an adequate amount of fertility, to the heaviest clay, if drained of its superfluous water. Its long tap-roots break up the stiff soil, and the material yielded by the roots and stubble is of itself equal to a good dressing of manure.

In mentioning the numerous advantages of under-draining, it is stated that rain water contains some of the most important elements of nutrition to plants, with considerable carbonic acid and ammonia. Permitted to percolate through the soil, the roots of plants, or, in their absence, the elements of the soil itself, absorb and form permanent combinations with them. Air also holds vegetable food that can thus penetrate through every portion of the soil where the fibers of the roots exist. Soils saturated with water admit little or no air, and this vital adjunct of vegetation is thus excluded. Under-draining also secures the porosity of the soil, thus facilitating the admission and escape of heat, which is of the utmost consequence in promoting the deposition of dews.

A chapter is devoted to the grasses, of which it is said there are no less than two hundred varieties cultivated in England; while, in the occupied portion of this country, with a greater variety of latitude, climate, and situation, we cultivate scarcely twenty. The number and excellence of our natural grasses, however, are probably unsurpassed in any quarter of the globe for a similar extent of country. This department of our natural history has been but partially explored. From the

health and thrift of the wild animals, as the buffalo, deer, &c., and the rapid growth and fine condition of our domestic animals, when allowed to range over the prairies or through the natural marshes and woods in all seasons, even during the severe and protracted winters in latitude 44° north, the superior richness and enduring permanence of our natural grasses may be inferred. Some twenty or thirty varieties that have been introduced and successfully cultivated are particularly described. Our native herd's grass, cat's-tail, or timothy, (*Phleum pratense,*) in nutritive quality now stands pre-eminently above any other. Both the grass and hay are highly relished by cattle, sheep, and horses. It is a perennial, of easy cultivation, hardy, and of luxuriant growth on almost any soil that is not wet, too light, dry, or sandy; and is also a valuable crop for seed, an acre of fine grass yielding fifteen to twenty-five bushels of clean seed, usually worth $2 to $4 per bushel, the stalks and chaff that remain making a useful fodder for most kinds of stock. It is is very extensively disseminated throughout this country and Europe. The Bermuda grass, in so high repute in the Southern States, is considered by Dr. Spalding, of Georgia, who examined them both critically, from specimens that he raised together, as the famous doob-grass of India, so highly prized by the Brahmins. On good meadows it yields four or five tons per acre. It is quite nutritive, and to the river planter invaluable. Mr. Affleck, of Mississippi, says there is not a levee on the banks of the Mississippi that could resist for one hour the pressure and attrition of its fearful flood, but for its being bound together with this grass. It loves a warm and moist, but not wet, soil.

A chapter on fertilizing barren lands is full of good suggestions. Allusion is made to the efforts making to reclaim the immense tracts of marsh land near Newark, New Jersey. If the experiment is successful, it will doubtless be followed by similar enterprises along our Atlantic coast, and among the extensive areas of swamp lands in the interior States, and millions of acres be thus reclaimed and rendered productive, fertile, and healthy.

In the chapter on domestic animals the principles of breeding are elaborately discussed, as well as the peculiarities and relative value of different breeds. An interesting fact is quoted from Dr. Playfair, who says that Lord Ducie, in an experiment in fattening cattle, placed one hundred sheep in a shed where they ate twenty pounds of Swedish turnips each, per day; another hundred were turned out in the open air, where they ate twenty-five pounds per day; yet the former, with one-fifth less food, weighed, after a few weeks, three pounds per head more than the latter. He then fed five sheep in the open air, between the 21st ot November and 1st of December. They consumed ninety pounds of food per day, the temperature being at 44°; at the end of this time they weighed two pounds less than when first exposed. Five sheep were then placed under a shed, and allowed to run about in a temperature of 49°. At first they consumed eighty-two pounds per day; then seventy pounds, and at the end of the time they had gained twenty-three pounds. Again, five sheep were placed under a shed as before, and not allowed to take any exercise; they ate at first sixty-four pounds per day; then fifty-eight pounds, and increased in weight thirty pounds. Mr. Childers thinks that eighty Leicester sheep in the open field consumed fifty baskets of cut turnips per day, besides oil-cake. On placing them in a shed they at first were able to consume but thirty baskets, and soon after but twenty-five, being only half the quantity required before, and yet they fattened as rapidly as when they ate the largest quantity. The result of these experiments shows that the minimum of food required

for the support of animals is attained when closely confined in a warm, dark shelter, and the maximum when running at large, exposed to all weathers.

The chapters on farm buildings and on domestic animals, poultry, bees, and their diseases, are full of interesting facts and principles.

How to Make the Farm Pay; or, the farmer's book of practical information on agriculture, stock-raising, fruit-culture, special crops, domestic economy, and family medicine. By Charles W. Dickerman, member of the Pennsylvania Agricultural Society, the American Pomological Society, and the Pennsylvania Horticultural Society; assisted by Hon. Charles L. Flint, secretary of the Massachusetts Board of Agriculture, and other practical agricultural writers. Illustrated with 140 engravings. Philadelphia: Zeigler, McCurdy & Co. 8°. 1869.

This is a subscription book of nearly 800 pages, made up chiefly with articles from modern agricultural books and periodicals. The chapters on drainage, plowing, manures, farm implements, grasses, grains, root crops, stock-raising, fruit culture, rural architecture, domestic economy, &c., are filled with familiar facts on these subjects. The book is also freely illustrated by engravings of agricultural implements, stock, &c., and contains more than two hundred useful household recipes, and a calendar of monthly work on the farm.

Rural Affairs: A practical and copiously illustrated register of rural economy and rural taste, including country dwellings, improving and planting grounds, fruits, and flowers, domestic animals, and all farm and garden processes. By J. J. Thomas, author of the American Fruit Culturist and Farm Implements; associate editor of the Cultivator and Country Gentleman. Vol. V. Four hundred engravings. 12°. 336 pages. Albany: L. Tucker & Son. 1869.

This volume continues the triennial series, which is made up from the matter published from year to year in the Annual Register for Rural Affairs. Its compact and neatly printed pages are filled with practical information on various topics. Its copious illustrations, and its original articles on subjects of agriculture, horticulture, and domestic economy, by some of the best agricultural writers of the day, are of permanent interest and value. Among these is one on Milk Farming, by Donald G. Mitchell ("Ike Marvel;") also two that are particularly valuable on Garden Insects, by Dr. Fitch, the State Entomologist of New York; the Management and Different Varieties of the Duck, by C. N. Bement; a Chapter on Various Practical Subjects, by S. Edwards Todd; the Culture of Small Fruits on the Hudson, by T. H. Burgess; Rural Improvements, by R. M. Copeland; Strawberry Marketing, by Edmund Morris; Improved Bee Culture, by M. Quimby; besides editorial articles on ornamental shrubs and flowers, grape-culture, rotation of crops, contrivances in domestic economy, &c., with numerous notes and items connected with country life, the whole making an interesting and attractive work.

American Horticultural Annual for 1870: A year-book of horticultural progress for the professional and amateur gardener, fruit-grower, and florist. Illustrated. 12°. 152 pages. New York: Orange Judd & Co. 1869.

American Agricultural Annual for 1870: A farmers' year-book, exhibiting recent progress in agricultural theory and practice, and a guide to present and future labors. Illustrated. 12°. 152 pages. New York: Orange Judd & Co. 1869.

These two works are well filled with original articles on leading topics of interest to farmers and gardeners, by writers who have made them specialties. Besides a calendar directing proper attention to details in fruit culture, the Horticultural Annual contains a description of the new gardening implements of the year; also, articles on the management and propagation of a new evergreen from Japan; on selecting and saving seeds; inarching the grape-vine; and notes on the new fruits, flowers,

and vegetables of the year, by Warder, Barry, Elliott, Fuller, Saul, and Gregory, whose practical experience gives value to their opinions.

The evergreen referred to is considered by Mr. Hoopes a great acquisition, being hardy even in the Northern States, and some of its varieties give promise of great beauty in the future. Mr. Comstock, in his article on raising seeds, says there is more difference in the breed of culinary plants than there is in animals, and by proper selection and cultivation the breed may be made to surpass the common stock as much, perhaps, in the one case as in the other. The production of seeds requires great experience and close observation in regard to the various influences operating upon their growth, as locality, elevation, and the adaptation of varieties to different soils. Even sea air affects some vegetables; the white French turnip, which is raised in such excellence on the sea-coast of Massachusetts, loses its character one hundred miles in the interior, where it runs into long necks and scraggy roots. In raising vegetables, if sown at the wrong season, their perfect development is prevented, as rutabagas sown too early make long necks; and common turnips, under similar conditions, become ill-shaped, overgrown, tough, and worthless. Climate, however, has the most potent and controlling influence. Melon seeds from the South do not ripen their fruit in perfection in the Northern States; neither do late cabbages from England, as they cannot stand the hot suns of our summers, though early varieties may, as they get their growth during the spring months. Cabbages that head well at the South, head still better at the North. Seeds of early vegetables from the North will be earlier at the South the first year; but if reproduced there, they grow later, and finally lose their early habits. Age weakens the vegetation and growth of seeds, though if not too old the crop may be benefited by it. Old cucumber and melon seeds run less to vines, and it is generally thought bear better; yet little fruit may be expected without a pretty good growth of vines; old radish and turnip seeds produce the handsomest roots, and the smallest tops; old lettuce seed produces plants which head the best, and stand the longest before running to seed. New seeds come up the quickest, and give the strongest growth of stalk and foliage.

The writer of the article on inarching the grape-vine has experimented in this practice with the most satisfactory results. By inarching the foreign varieties on native stocks more vigorous growth is obtained, time is saved, shanking and shriveling to a great extent prevented, and the necessity of constructing expensive borders obviated. The adaptability of vigorous growing native vines for stocks has been tested. On the native Clinton as a stock, the Gros Maroc, Black Hamburg, Purple Constantia, Chasselas Vibert, Black Bordeaux, Black Prince, and White Tokay have been inarched by the writer with results more than satisfactory. He has over twenty varieties inarched on Concords and Clintons, of which detailed results are promised. Grafting the vine is an uncertain and unsatisfactory operation. It frequently fails, and if the vine is grafted below the surface of the soil, the cion sends out roots and the desired results are thus somewhat counteracted. By inarching, which can be done on either ripe or green wood, success is beyond doubt, and the cion is absolutely dependent on the roots of the stock for nourishment. Precise directions, with a figured illustration, are given for the process. Inarching the vine is an old operation, but, like many other old things, has been much neglected. It is worthy of the renewed attention of grape-growers.

In describing the new apples of 1869, Dr. Warder pays particular attention to the new seedlings of the Siberian Crab family. This section

of fruit is an important one to farmers in the Northwest, who annually lose thousands of trees from the severity of the winter, although they have endeavored to secure the most hardy kinds from the Eastern States. Careful descriptions, with outlines, are given of some eighteen or twenty Siberian seedlings, many of beautiful appearance, of good flavor and size, and which keep through the winter.

Mr. Barry, in his notes on the pear crop of the past year, says it came fully up to the average, not only in size but in quality. This, with his previous experience, convinces him that the pear is one of the most reliable of our fruit trees, bearing, with proper attention, good crops every year, even in seasons excessively dry or wet. The blight has been less prevalent than usual; and as it seems to decrease every year, he hopes it will soon cease to be a serious obstacle in pear culture. Mr. Barry says:

> The introduction of California pears does not seem to have affected the market, nor is it likely to do so in the future. The quality of the fruits is generally inferior to ours. They are larger, coarser, and deficient in flavor. I have seen only one sort, the Beurré Clairgeau, that was better than we get it—more melting and higher flavored. The later pears, and especially those of firmer texture, are the most likely to be improved in the climate of the Pacific coast. That noble fruit the Easter Beurré, so seldom brought to its perfect condition here, promises to succeed well there. I have seen specimens weighing 18 ounces, and have no doubt that it often attains a much greater weight. Very few new varieties of importance, either of native or foreign origin, have been brought to notice during the year.

A. S. Fuller represents the crop of small fruits in 1869 as greater than ever before known. The season was favorable, and their culture has been largely extended within a few years. Owing to these circumstances, with the enormous peach crop, prices ruled very low, to the great satisfaction of consumers.

A description of the new vegetables, ornamental plants, roses, hardy trees and shrubs, garden implements, &c., follows. The book closes with a list of all the dealers in fertilizers, implements, seeds, &c., in the country.

The *Agricultural Annual* is on a similar plan, but devoted to the heavier operations of farming. It is filled with articles on the late inventions affecting agriculture; the characteristics of different breeds of thorough-bred stock; progress in fish culture; earth-closets; potatoes and other root crops; drainage; cheese making, and other agricultural matters, closing with a farmers' directory.

PUBLIC PARKS: Their effect upon the moral, physical, and sanitary condition of the inhabitants of large cities; with special reference to the city of Chicago. By John H. Rauch, M. D., member of the board of health, sanitary superintendent, and register of vital statistics of Chicago. 8°. 104 pages. Chicago: S. A. Riggs & Co. 1869.

Dr. Rauch discusses the benefits of public parks upon the moral, physical, and sanitary condition of the inhabitants of large cities. His work comprises a brief sketch of what has been done in both ancient and modern times, at home and abroad, in establishing parks, promenades, and groves, with a view to adornment and to affording agreeable places of resort, which shall also prove efficient aids in promoting public health. After an account of the villas, rural retreats, and pleasure grounds of Grecian and Roman civilization, the public parks of Great Britain and the Continent are described with much particularity, as well as the prominent ones of this country. The oldest botanical garden in the United States was laid out by that great naturalist, John Bartram, near Philadelphia, more than a century ago, and it is a curious fact that such was his enthusiasm and love for the rare trees he had planted, that his fears of their destruction by the British, immediately after the battle of

Germantown, so preyed on his mind as to hasten his death in a few weeks after that event. During the last twenty-five years an astonishing progress has been made in landscape gardening, and in all our principal cities public parks and shaded promenades have been laid out, more or less elaborate, although necessarily still unfinished. They form an attractive feature in the surroundings of any great city, and constitute the peculiar charm of many country villages. This country can boast, also, of the finest rural cemeteries in the world.

Apart from the consideration of mere embellishment, Dr. Rauch discusses the question how far man can modify climate by planting trees, of which so many places have been denuded, and thus "restore the disturbed harmonies of nature." Many interesting proofs are given of the influence of vegetation, particularly of trees, upon health. It is asserted that a family in New Jersey that had always been healthy was attacked by fever in consequence of the cutting down of a wood that separated them from a neighboring morass. Army physicians always recommend having a wood, if possible, between marshy grounds and an encampment. In Rome whole families now live near the Pontine marshes, and by the introduction of shrubs and trees have escaped for years the fatal effects of the mephitic vapors which these putrid marshes engender. Dr. Lewis, in his medical history of Alabama, gives many facts to show the lamentable effects on the healthiness of places that have followed the destruction of forests growing between them and marshy lands. In our late war much of the sickness in the Army of the Potomac in the summer, autumn, and winter of 1861, was ascribed to the great destruction of trees about the camps. The same result was also observed in many places in the South. In Guiana and Surinam, so notoriously unhealthy, it is surprising how near to the leeward of the most pestiferous marshes people will settle and preserve their health, provided they have the protection of lofty umbrageous trees between them and the swamps. Dr. Rauch's book abounds with cases of a similar nature.

Trees also modify the range of temperature by conveying heat from the air to the earth in summer, and vice versa in the winter. In summer, plants and trees, in addition to their condensing powers, render the atmosphere cooler, by the great quantity of water exhaled from the leaves during foliation. When the vast perspiring surface presented by a large tree in full leaf is considered, it is evident that the quantity of watery vapor it exhales is immense. The "Washington Elm" on Cambridge Common, a tree of no extraordinary size, was estimated by Professor Gray, a few years ago, to produce a crop of seven million leaves, exposing a surface of two hundred thousand square feet, or about five acres of foliage. Bishop Watson placed an inverted glass vessel of the capacity of twenty cubic inches on grass which had been cut during a very intense heat of the sun, after many weeks had elapsed without rain; in two minutes it was filled with vapor, which trickled down its sides. These drops were collected on a piece of muslin and carefully weighed, and repeating the experiment for several days between 12 and 3 o'clock p. m., he estimated that an acre of grass transpires upward of six thousand quarts of water in twenty-four hours. This is probably an exaggerated estimate, as the amount transpired during the period of the day in which the experiment was tried is far greater than at any other. The refreshing coolness of a grove, then, is not to be wondered at, though many while enjoying it have supposed it was the result of shade only. This exhalation is dependent on the capacity of the air for moisture at the time, and the presence of the sun, while frequently it is scarcely perceptible at night.

Dr. Rauch says:

It is the uninterrupted sweep of the winds, rather than the intensity of the cold, which abstracts the vital energy of the system. The trapper in the Hudson's Bay region, amid the stillness of the forest, day after day pursues his accustomed round, with the thermometer many degrees below zero, with little or no inconvenience; and so, too, with the lumberman in the pineries of Maine and Wisconsin. The human system is constantly giving out a volume of heat, which is abstracted more readily by the movement of the air than by mere radiation into space. This deprivation of carbonacious matter, and the chilling and exhausting effect incident to it, are but too well known by the prairie traveler in winter. The same effect is apparent in operating a locomotive during very cold or windy weather, as it is found much easier to keep up steam while the engine is passing through woods than over the wind-swept grounds, although the thermometer may indicate the same temperature. As soon as the train emerges from the shelter of the trees, the steam-gauge falls, and a more liberal supply of fuel is necessary to bring it up again. Trees and plants exercise a marked influence on the humidity of the air, causing its moisture to be more equally distributed. They also act as exciters or conductors of electricity, and it is supposed that, in countries where hail storms are frequent and destructive, they occur in proportion as the forests have been cleared. Meguscher says that electrical action being diminished, and the rapid congelation of vapors by the abstraction of heat being impeded by the influence of the woods, it is rare that hail or water-spouts are produced within the precincts of a large forest when it is assailed by the tempest. May not the tornadoes so common throughout the north-west several years ago be owing to our treeless prairies?

Dr. Rauch closes his book with remarks on the influence of climate on the most common diseases and epidemics, as well as on the mind; the whole work forming a strong plea for the establishment of public parks in or near all our large cities, for the purposes of recreation, enjoyment, and health.

Weeds of Maine: Affording popular descriptions and practical observations in regard to the habits, properties, and best methods of extermination of nearly all the weeds found in the State. By T. Lamson Scribner, of the second class of the Maine Agricultural College. Augusta, Maine: Sprague, Owen & Nash. 8°. 62 pages. 1869.

The subject matter of this work is indicated by its title page. It describes nearly two hundred and fifty "plants out of place," now common in Maine, which are not entitled to respect for their medicinal or other useful qualities, or noticeable for the beauty of their flowers. Most of these weeds are said to be immigrants from the old world, or from the warmer portions of this continent, the number of indigenous plants deemed pernicious weeds being comparatively small. Mr. Scribner gives a scientific definition of each plant, which is followed by a popular description of its character and habits, its locality, and the best method for its extermination. He has thus produced a work of interest to general readers as well as to farmers.

In speaking of the common field or sheep sorrel, (*Rumex acetosella*,) he terms it "a despicable little foreigner," as troublesome as the Canada thistle or witch-grass, and quite as difficult to eradicate. He thinks that the prevalent idea that this plant, when abundant, indicates a sour soil, to be neutralized with an alkali, is fallacious; and that, because the leaves of the sorrel are sour, we are not to suppose that the soil upon which it grew is sour also, any more than that the soil on which crab-apples are grown is sour also. "Very sweet and exceedingly sour apples are frequently found on the same tree. The acidity which we find in certain plants is not drawn directly from the soil, but is a vegetable product. Sorrel will grow upon a limy soil as well as upon any other. The only effect which the application of lime has to eradicate sorrel is in its promoting the growth of other plants which tend to choke it out. The prevalence of this plant is a strong indication of a light or impoverished soil, and its extirpation can be effected only by high cultivation or rotation of crops."

Field mustard (*Brassica sinipastrum*) has made its appearance the past

year in Waterville, Maine. It has long been a pest in grain fields from New York and Pennsylvania westward, and is a most unwelcome intruder. Tares, corn spurry or devil's flax, (*Spergula arvensis*,) is cultivated in Europe as a forage plant, sheep and cattle being very fond of it; it is there thought to enrich the milk of cows, as well as the quality of mutton fed on it. It is also a popular notion that, as hens eat it greedily, it makes them lay a great number of eggs. In this country it is found in grain fields and cultivated grounds, and is considered a pernicious weed.

The poison ivy (*Rhus toxicodendron*) is often mistaken for that ornamental climber, the woodbine, (*Ampelopsis quinquefolia*,) from its great resemblance; but the two may be readily distinguished by observing that the woodbine leaf has five oblong leaflets, while the leaf of the poison ivy has but three. The poison ivy should not only be known to the farmer, but also be diligently expelled from his premises.

The thorny clotbur, (*Xanthium spinosum*,) justly stigmatized by Darlington as an "execrable weed," within a few years has been creeping into the grass lands of Maine. High cultivation may eradicate it. The wild chamomile (*Maruta cotula*) is very common in hard, dry soils, by roadsides, and in yards.

The Canada thistle (*Cirsium arvense*) is the most "execrable weed" with which the farmer has to contend. It prefers a rich soil, but will grow in almost any, if not too wet. It is so great a pest in France that a man may prosecute his neighbor who neglects to destroy the thistles on his grounds at the proper season, or he may have it done at the other's expense. Similar laws have been passed in several Western States, with excellent effect.

Of the Sedge family (*Cyperaceæ*) there are a hundred and twenty different species found in Maine, growing principally in moist meadows, marshes, and swamps. They are all worthless weeds, and destitute of the rich nutritive qualities that characterize the grasses, and make them so valuable to the farmer. None of them are worthy of cultivation.

Cheat, or chess, (*Bromus secalinus*,) a partly naturalized weed from Europe, is too common in slovenly cultivated grain fields. It is singular, in the present state of knowledge, how widely the error prevails that chess is degenerate wheat. It belongs to an entirely different genus. Several years ago, when it was first introduced from Europe, it was known as Willard's chess, and fabulous prices were offered for the seed; but it was not long before the true character of the plant was found out, and the people became aware that they had been doubly "cheated," for the grass was both too meager in quantity and too poor in quality for cultivation, and they had been encouraging the growth of a troublesome weed. To exterminate it, sow clean seed and keep the waste grounds clear of the plant. The seed is much smaller than the grains of wheat, from which it is separated by the best modern fanning mills. Both the high and the running blackberry are common throughout the country. They are often very troublesome, spreading extensively in neglected fields, by their large creeping roots, which send up new plants at short intervals. Although the fruit is delicious, it is still much better to cultivate in gardens the new valuable varieties grown by nurserymen, and to destroy the wild plants about the farm. The latter will disappear under good cultivation.

THE ANGORA GOAT: Its origin, culture and products. By John L. Hayes, secretary of the National Association of Wool Manufacturers. 8°. 38 pages. Boston: A. A. Kingman.

This work is the substance of an essay read before the Boston Society

of Natural History, last year. It comprises known facts in regard to the origin, history, and character of the valuable breed of goats from Angora. The writer doubts the feasibility of attempting crosses of the pure Angoras with the common goat, as the chief object desired is a class of animals that shall produce a textile material adapted to certain defined purposes in the arts, as distinct as silk, Saxony wool, or Sea Island cotton—a material which is a substitute for nothing else known, and has originated its own fabrics. The introduction or development of a race which cannot give this peculiar fiber would be no real acquisition, however amusing to the breeder and interesting to the physiologist the experiments in crossing might be.

The Angora goat and the domestic goat of Europe and of this country having descended from separate sources, the attainment of good results from the crosses of these two races is theoretically improbable, and is demonstrated to be so by the best experience in Europe. The normal fiber desired for the textile arts is to be found only in flocks of the thoroughly pure race, and perhaps in flocks bred back to the standard of the pure race by crosses of a perfectly pure buck with the black Asiatic goats of the same race. It is desirable that importations should be made with the black female Kurd goat of Asia Minor for crossing with the pure white bucks. There is evidence of great weight in favor of good results from such cases. Mr. Hayes says:

> Systematic measures of acclimation must always be impeded by the eagerness of breeders for sale to obtain merchantable results. The appropriation of this race is of sufficient importance to deserve the earnest attention of the national government, as the best races of the Merino sheep have been secured only through the persevering and disinterested efforts of governments of Europe. * * * * * *
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> The cost of a single Rodman gun would secure a magnificent flock, to serve for prolonged experiment and as a model to our agriculturists. Producers cannot expect to obtain remunerating prices for their fleeces until the manufacture of mohair fabrics is established in this country. It must be years before a sufficient supply is grown here to occupy a single mill. The fleeces of over ten thousand sheep are consumed every week in the single establishment of the Pacific Mills. It is probable that there will be a demand for all that can be grown for some time, for yarns, for braids, and for Astrachan cloakings, which are being made in Rhode Island. The demand for animals of the pure race will increase also without reference to the value of the fleeces. There are enough agriculturists of taste and wealth in this country who will readily pay large prices for these docile and beautiful animals simply as ornaments for their farms.
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> The greatest obstacle to permanent acquisition of new resources from any department of nature is exaggerated expectation as to their value and facility of acquirement. Our impatient countrymen need to be reminded that real progress is the offspring not only of human effort, but of time. * * * There is encouragement, however, in the fact that the fruits of decades or centuries in older countries are matured here in years. In how brief a time has this vast country been stocked with all the animal wealth which Europe had to bestow! How rapidly have we appropriated all the best ovine and bovine races of the old world! Within half a century we have spread the Merino sheep over all the prairies of the West, and within a less period have acquired and perfected the cattle of the Durham short-horn breed, and even sent them back to ameliorate the parent stock in England. The hope is not vain that the precious race, which in its slow march westward we have traced from the remote east, may at no distant time be fully secured for the western world.

How Shall we Paint our Houses? A popular treatise on the art of house-painting, plain and decorative, showing the nature, composition, and mode of production of paints and painters' colors, and their proper and harmonious combination and arrangement. By John W. Masury. 16°. 216 pages. New York: D. Appleton & Co. 1869.

The art of house-painting in itself would not seem to be an attractive topic for a book; but Mr. Masury has produced one of great interest, that comes home to us all; and on which in no small degree depend our comfort, pleasure, and health. He has elevated the business of house-painting, and really placed it among the fine arts. To-day it does not imply simply the covering of the wood-work of the house with one

or more coats of white paint, but it requires the exercise of those faculties that distinguish the artist from the mechanic. "An eye prompt by nature and education to distinguish the nice gradations of colors and tints, and the faculty so to arrange and dispose them as shall best harmonize them with each other and with the surroundings, are indispensable in the house-painter of the present day. Happily the day for dead whites for the interior of dwellings has passed by, let us hope, not to return. It was a kind of Puritanism in painting, for which there was no warrant in nature, which in such matters should be our teacher and guide." There is no reason in the custom of painting the walls and interior wood-work of our dwellings with one unvarying color, that will not apply with equal force to the carpets, hangings, and general furniture.

The business of house-painting has wholly outgrown its former insignificant proportions, and more money is now frequently expended in painting and decorating a single edifice than would have sufficed to paint every house in a town thirty or forty years ago. For the outsides of buildings the ochers, or earth paints, which are in inexhaustible supply and of almost universal distribution, are recommended as the best and cheapest, being inert substances that in no degree change the nature of the oil; while some metallic paints, as white lead, affect it chemically and impair its tenacity and its property of resisting the action of water and the sun's rays. White lead soon turns chalky, and rubs off when brought in contact with the hand or clothes.

The preparation of colors, the manufacture of white lead, (of which over 20,000 tons are annually used in the United States,) and the various pigments are amply described. Chapters on color-blindness, a theory of colors, decorative house-painting, the harmony and discord of colors, follow, in the last of which the author says:

Every house, barn, outbuilding, or frame becomes when painted a more conspicuous object in the landscape than it otherwise would be; and the cost of painting the same in conformity with the laws of harmonious arrangement and proper adaptation to the surroundings, is no greater than to paint in such a manner as to set all these laws at defiance.

For example, the surroundings of most country houses reflect to the eye the various hues of green. Now, red, brown, and green in juxtaposition produce horrible discord. A yellow, partaking of the orange hue, on the contrary, makes agreeable harmony. Red, brown, and chocolate colors are altogether unsuited to the painting of country houses. They are out of place in a landscape, and cannot be made to harmonize with the surroundings. Some tone of yellow is preferable, particularly when the house has green blinds attached to the windows. It is not in good taste, however, to use white for the trimmings, window frames, cornices, &c., with yellow. White and yellow are poor and feeble, and are wanting by analogy; the yellow loses by the connection. A rich shade of brown (not red-brown) is proper for trimmings, in contrast with yellow, and makes very pleasing harmony. Bright green blinds, also, are more agreeable with yellow than with any other color which would be suitable for painting the exterior of a country house. Next to yellow, the yellow drabs and stone colors are recommended.

THE CIDER MAKER'S MANUAL: A practical hand-book, which embodies treatises on the apple, construction of cider mills, cider presses, seed washers, and cider mill machinery in general; cider-making, fermentation, improved process in refining cider, and its conversion into wine and champagne; vinegar manipulation by the slow and quick processes; imitation ciders, various kinds of surrogate wines, summer beverages, fancy vinegars, &c. By J. S. Buell. 12°. 182 pages. Buffalo: Haas & Kellogg. 1869.

Cider making, which, fifty years ago, was an important branch of the farmer's business, had fallen into comparative disuse, until within a few years; but a change in public taste, and the development of improved and economical machinery for making a pure article, have led Mr. Buell to prepare the foregoing treatise. Some general observations on the

uses of wine, cider, and the juices of various fruits, are followed by a description of the different economical mills now in use, showing a wonderful improvement on the clumsy apparatus and large wooden screws used in the beginning of this century; directions in the selection of fruit, with general rules for making and managing cider, as well as vinegar, and all sorts of domestic wines, comprising more of the details, hints, and recipes that have been published on these subjects, and which are now presented in a form accessible to all readers.

The orchard products of this country have not kept pace with the demand, and they are now among its most profitable crops. The apple tree, though of slow growth, is hardy, free from disease, and lives, ordinarily, from fifty to one hundred years. Therefore thousands of acres of hilly land could be profitably planted with it, where other fruits and other crops are grown with difficulty. An immense trade has grown up in the shipment of selected apples, and so superior is the fruit of our own country, that in the English market American apples command almost fabulous prices, and in our domestic markets there has been a steady appreciation of prices for several years. In the manufacture of cider, ripe, sound fruit is the only basis for a good article. Apples that have lain on the soil for any length of time should be discarded, as they contract an earthy taste, which will always be found in the cider. The old-fashioned mode of placing straw between the layers of pomace is condemned, as when heated, or if foul and musty, the straw gives a disagreeable taste to the liquor. Instead of straw, two layers of haircloth should be placed between each four or five-inch layer of pomace, which facilitates the free passage of the liquor from it. Gunny cloths, hop or wool sacking answer this purpose nearly as well, and are much superior to straw. It must be borne in mind that two layers of cloth should always be used; this allows the cider to pass through with great facility. Dissatisfaction is pretty sure to follow the use of only one thickness.

The strongest cider is made from apples containing the smallest percentage of juice, and its watery solution the largest proportion of saccharine matter. Its color may be materially varied by the management of the pulp, though its quality is thought to be deteriorated in proportion to its increase of color. A few quinces are ground with the apples in certain localities, which, to the taste of some persons, improve its flavor. The cider made from the Virginia crab also has a great reputation. It is slightly astringent, of light color, keeps well, seldom becomes turbid, and when bottled holds its carbonic acid gas better than any other. Specimens of this cider five or six years old are occasionally found, and sold at extravagant prices.

THE CRANBERRY CULTURIST: A concise practical treatise on the cranberry; its history, culture, varieties, &c., with special reference to the Bell variety, and its culture on marsh and upland soils. By F. Trowbridge, Milford, Connecticut. New Haven: Hoggson & Robinson. 1869.

This is a brochure of a few pages in which the author has condensed much information on the cultivation of the cranberry. This fruit has become a great luxury in Europe as well as in this country, and brings a high price in the West Indies and other tropical climates. Although the plant is indigenous on both continents, and grows wild in many parts of the world, yet the American cranberry is the largest, deepest colored, and richest flavored that appears in the European markets. When the crop is sufficiently large in this country to allow a surplus for exportation, the fruit becomes quite an article of commerce, being packed in water in small kegs, and sometimes in sealed bottles filled with water. In this latter style it is sold by the fancy grocers in Lon-

don at extravagant prices. It is now an important crop on the apparently worthless, sandy, and swampy soils of Cape Cod, Massachusetts; and the "Cape Cod cranberries" take the lead in all markets. As the plant derives its nourishment chiefly from the air and water, it is of little consequence how poor the soil may be; that which is light and destitute of organic matter is the most desirable.

Experiments in New England indicate that the cranberry can be cultivated on uplands, though generally with only moderate success. The kind commonly used for this purpose is the *Vaccinium oxycoccus*, a small round berry, about the size of a pea. On Long Island, however, there are cranberry patches of five or six acres on high upland soils, good for nothing else, that produce fifty to one hundred bushels per acre, which is considered a satisfactory result, as manure is unnecessary, and the trouble of cultivating, gathering, and marketing the cranberry is less than that required by the strawberry, blackberry, or any other of the small fruits.

In some places experiments have been successful in raising the cranberry in ordinary garden soil; and Mr. Downing has stated that a plat of the size of twenty feet square, planted properly, will yield three or four bushels annually—quite sufficient for a family. For ornamental purposes, also, its culture as a house plant is highly attractive.

The Bell variety grows freely in pots, and its erect growth, its bright emerald foliage, gemmed with delicate flowers and rich clusters of crimson, coral-like fruit, render it a pretty ornament to the parlor or conservatory.

PARSONS ON THE ROSE: A treatise on the propagation, culture, and history of the rose. By Samuel B. Parsons. A new, revised, and illustrated edition. 12°. 215 pages. New York: Orange Judd & Co. 1869.

This new edition of Mr. Parsons's work has been carefully revised, its poetical quotations omitted, as somewhat irrelevant, and much care bestowed upon its botanical and garden classification. The author gives the conclusions of his own experience, as well as the satisfactory results of other cultivators, and has produced a practical manual of moderate size and cost. In his chapters on the botanical classification of the rose, the technical description of the leading varieties is relieved with historical sketches and curious facts of a popular character. Although this shrub has been a universal favorite from the remotest antiquity, it is only within a century that it has received prominent attention from cultivators. New species have been introduced from China, the East Indies, Persia, Hindostan, and our western prairies, that have been hybridized with others, producing flowers of surpassing beauty and variety. The "thirty sorts of rose" of which Parkinson wrote in 1629, and the fourteen species known to Linnæus in 1762, have now been increased to more than six thousand kinds, the poorest of which are superior to the most highly esteemed of those days. Fifty or sixty years ago there was but one variety of the moss rose cultivated; now there are more than one hundred. During this period many flowers, as the dahlia, tulip, &c., have had their day as special favorites, but the rose still retains its pre-eminence as the most beautiful product of the floral kingdom. The introduction of the Bourbon rose into France in 1819, from the Isle of Bourbon, and the Remontant or perpetual class, the easy culture of the plant, and the intrinsic merit and beauty of the flower, have all contributed to this result. In France its culture is a leading object with florists, both in commercial and private gardens, and we are chiefly indebted to the French for the finest varieties. The English gardeners have paid less attention to ob-

taining new varieties, than to the careful culture and improvement of those already known.

The rose is, perhaps, the longest lived of all shrubs. There are some growing in England of immense size, indicating great age; there is one near Bristol, Pennsylvania, which is known to be over one hundred and twenty-five years old, and has never failed to produce a profusion of flowers, regaling five generations with their delicious perfume. General Frémont found wild roses growing on the prairies five hundred miles west of St. Louis, "scattered in small bouquets, and when glittering in the dews and waving in the pleasant breeze of the early morning they are the most beautiful of all prairie flowers." The Macartney rose, with its uncommonly rich, glossy evergreen foliage, gemmed with fragrant flowers, was brought from China in 1793, by Lord Macartney, the English embassador. When the allied armies entered Paris in 1814, the Empress Josephine had 10,000 seedling roses growing there which her gardener saved from destruction. These and hundreds of other curious facts are scattered through Mr. Parsons's book, in his descriptions and sketches of the best varieties.

A description of the most desirable sorts of the rose is followed by chapters on its culture, propagation, and hybridizing; its diseases and insect enemies; its early history and associations, and its economic uses, perfumes, and medical properties.

THE ILLUSTRATED ANNUAL REGISTER OF RURAL AFFAIRS, AND CULTIVATOR ALMANAC FOR THE YEAR 1870, containing practical suggestions for the farmer and horticulturist, with about 150 engravings. By J. J. Thomas, author of the "American Fruit Culturist," and "Farm Implements," and associate editor of the Cultivator and Country Gentleman. 18mo, 144 pages. Albany, New York: Luther Tucker & Son.

Within the compass of 144 pages, and at the reasonable price of 30 cents, will be found carefully prepared and illustrated articles on the culture of our great staple, Indian corn; on draining; fence making; management of fractious cows; the proper construction of stone walls; town and country roads; farm buildings; fruit culture; ornamental plants; measuring and mapping farms; various contrivances in rural economy; domestic management, recipes, &c.; concluding with a Farmer's Register of the names and locations of the principal breeders of improved stock, seedsmen, manufacturers of agricultural implements, dealers in fertilizers, &c.

AGRICULTURAL QUALITATIVE AND QUANTITATIVE CHEMICAL ANALYSIS: After E. Wolff, Fresenius, Krocker, and others. Edited by G. C. Caldwell, professor of agricultural chemistry in the Cornell University. 12°. pp. 306. New York: Orange Judd & Co. 1869.

Professor Caldwell in this work has furnished a manual of chemical analysis, for the use particularly of agricultural students. Much of the information has been until now practically unavailable, from being scattered through short articles in French and German periodicals, or shut up in elaborate treatises in those languages. It required a judicious hand to systematize such a mass of material. The qualitative and quantitative processes that are described refer only to such substances as are found in soils, plants, animals, fertilizers, or other materials or products of agriculture; and to reduce the size of the book as much as possible, except in two or three instances, only those methods of analysis are introduced which are most commonly used by good chemists, and have been tried and found reliable, with such improvements as have been made in recent practice.

Instead of the old system of atomic weights, and of the old nomenclature, which might have appeared more simple to most students at

first, Professor Caldwell has deemed it expedient to follow the common usage in the best recent works on chemistry. The same course has been pursued in regard to the use of the centigrade thermometer, and the metric system of weights and measures. It is undoubtedly the most complete hand-book of agricultural chemical analysis in our language, and must prove very useful in the agricultural colleges recently founded by grants from Congress.

A HELPING-HAND FOR TOWN AND COUNTRY: An American home book of practical and scientific information concerning house and lawn, garden and orchard, field, barn, and stable, apiary and fish pond, workshop and dairy, and the many important interests pertaining to domestic economy and family health. By Lyman C. Draper, secretary of the Wisconsin Historical Society, and W. A. Croffut, author of the History of Connecticut, &c., introduction by Horace Greeley; with 200 illustrations. Royal 8°, 821 pages. Cincinnati: Moore, Wilstach & Moore. 1869.

In this volume all branches of farming, orcharding, and gardening are discussed, as well as the architecture of the homestead, the workshop, tools and implements, domestic economy, family health, farm economy, and the kitchen and the dining room. It has an introductory essay by Horace Greeley, on the first truths in agriculture, the treatment of the soil, and practical tillage in the West, with reference to manures, irrigation, steam-plowing, drainage, &c. The editors have accumulated numerous experiments, and from the average results have endeavored to draw some approximate solution of the many vexed problems of planting, harvesting, breeding, &c.

In the introduction Mr. Greeley recommends the use of gypsum on farms remote from the seaboard, as its elements enter into the composition of animal and vegetable structures, and its sulphur is held to have a far greater affinity for ammonia than for lime, so that when liberated by grinding, and sown over the ground, the ammonia taken up by the breezes wafting over barn-yards, pig-pens, decaying carcasses, fetid swamps, drains, &c., eagerly combines with the sulphur of the gypsum, and forms a sulphate of ammonia, instead of a sulphate of lime, leaving the lime free. Ammonia is one of the most potent stimulants of plant growth, which explains the apparent disparity between the small quantity of gypsum, one to three bushels per acre, and the great results produced. Mr. Greeley asserts that, on such farms as are referred to above, no other commercial fertilizer returns, on an average, so large or so prompt a recompense for the cost of its application as gypsum—often ten for one; that is, ten dollars in the increased quantity or value of the crop for each dollar's worth of gypsum applied to the soil. Common lime has often effected great and enduring improvement, but in no such proportion as this.

Mr. Greeley urges farmers to increase and make the most of home-made manures, adding that millions of farmers have gone into bankruptcy for want of home-made manure, but he never heard of one who was bankrupted by making and using too much of it. On eastern granitic soils he considers unleached wood ashes worth 30 to 50 cents per bushel; but less on the western prairies, of which the soil is largely composed of ashes. Even leached ashes are worth carting half a mile, and applying to very light, warm soils.

Irrigation, so much neglected by American farmers, is urgently recommended. Some successful farmers consider water the cheapest and and best of all fertilizers. The annual product of the fertile plains of Lombardy is fully doubled by judicious irrigation, which has also produced so astonishing results in Utah. Mr. Greeley estimates that

> Fully one million American farmers could dam and turn aside a brook or runnel so as to irrigate at pleasure two to ten acres of their several farms, at a cost of $100

on the first outlay, and $10 per annum afterward, if they would; and that the average increase of their products respectively would not fall below $100 per annum. This, of course, is but a beginning. Ultimately we must dam larger streams, rivers even, and irrigate by means of little canals, from ten to a hundred square miles from a single dam. Let the water be drawn off when it is highest and richest, and sent meandering gently among fields of grain and grass and vegetables, ready to be let on as their needs shall indicate, and we shall have an instant increase in our present annual product to the extent of many millions, with a steady augmentation of the fertility and productiveness of our agriculture for ages to come. Every acre wisely irrigated one year will prompt the irrigation of two more acres the next year, and so on, till all our lands that can be plowed, by skillful engineering, at a cost below $50 per acre, will have been provided with the means of illustrating the marvelous productiveness of the narrow valley of the Lower Nile.

Nor shall we stop here. I hold the prairies admirably adapted to irrigation. Choose the highest points or swells that can be found; dig on each a deep well, and place a self-regulating windmill over it; dig a basin by its side, and the windmill may take its own time for filling it. If the water is brackish, or hard, or otherwise mineralized, so much the better as a general rule, though there may be exceptions. When the suns of May and June have thoroughly warmed the reservoir, begin to draw it off through shallow ditches, leading along the highest swells or ridges, and let it ooze out from time to time to give moisture to the growing crops during the thirsty heats of July and August. I do not believe there is a prairie county in which irrigation may not be largely inaugurated at a net profit, at least, of nearly twenty-five per cent. per annum on the total cost.

Good farming vindicates itself by a constant increase of the capacity of the soil. The farm that would scarcely keep a dozen head of cattle when the good farmer took it in hand, soon amply subsists twenty, and by and by forty or fifty. It turns off more produce year after year, but in the shape that least exhausts the soil: in beef, pork, or live stock, instead of hay and grain. Nine-tenths of all that the soil yields are thus returned to it as manure, while the free use of muck, gypsum, &c., is continually increasing its product in quantity and value. As a general rule, I hold that no farmer ever enriched himself by a husbandry that impoverished, or even failed to enrich, his farm

Certain plants (clover pre-eminent among them) draw nourishment from the atmosphere, and impart fertility to the soil. These are wisely grown by every good farmer but to one who has not muck at command they are indispensable. Wherever the soil is deficient in vegetable matter, as I have often found it even in the West on the openings or "barrens," clover affords the cheapest and readiest corrective. If I were buying land, my first inquiry would be, "Will it grow a good stand of clover?" If it will it may be easily made to produce wheat, corn, or almost anything else.

I hail with gladness every premonition of the coming steam plow, not so much because steam will pulverize our soils more cheaply than we now attain that end, but because it is sure to do the work more thoroughly, more profoundly. The rich deep soil of the prairies predicts and demands the steam plow; its coming cannot be much longer delayed; and when it shall have become as familiar as the reaper and the cultivator now are, I am confident that we shall pulverize the soil to a depth of at least two feet, and find that none too much. Then we may defy a drought of five or six weeks to stop the growth, or curl the leaves, of our corn; then we may defy the protracted rains often experienced in May and June to stop our work or keep our young plants for days under water. We shall still employ, and profit by, irrigation to increase the luxuriance of our crops, but we shall no longer watch the skies with painful apprehension that five or six weeks of daily fervid sunshine without rain will blast our hopes of a harvest.

As to drainage, we know that marshes, and, in fact, any land surcharged with stagnant water which is carried off by the slow process of evaporation, are unhealthful, breeding agues and other bilious diseases; they breed also mosquitoes and other detested insects, and are often unsightly obstacles to symmetrical and economical cultivation. Let any farmer begin by draining his wettest acre from which the requisite fall can be obtained, draining it completely and durably, and I am sure he will not stop at that, but proceed to drain more and more, as means and time shall allow. I have twelve to fifteen acres of natural bog or peat swamp, from which a sufficient outlet is secured with great difficulty, the level being maintained for a full mile below it, yet I have drained it so that I have corn growing on eight acres of it, and have had good oats and grass this season on the residue, where, though surrounded with tillage for two centuries, nothing but weeds and coarse worthless swamp grass had grown till I took hold of it. I believe this land to-day worth all it has cost me, which is twice what a farmer living and working on his own land need have paid to achieve like results.

As a thousand topics are discussed in the body of the work, embracing the whole range of country life, we cannot give even an abstract of the articles, and readers are referred to the book itself.

HAND-BOOK OF THE SULPHUR CURE, as applicable to the vine disease in America, and diseases of apple and other fruit trees. By William J. Flagg, author of Three Seasons in European Vineyards. 12°. 94 pages. New York: Harper & Brothers, 1869.

In this work Mr. Flagg describes his successful treatment of mildew on grapes by the sulphur cure, as he learned it in Europe; that is, by applying finely-powdered or sublimated sulphur to the vines, with a properly constructed bellows. In his Three Seasons in European Vineyards, noticed in our last annual report, he warned grape-growers of their danger from the spread of the vine disease, urging them to adopt the remedy which had proved so efficacious in other countries. The uncommonly severe and wide-spread pestilence that attacked the vines the past year has shown that his warning was timely, and that the disease was not occasioned by certain soils or situations, nor confined to any varieties of the vine.

As vine-growers are giving up their old theories, and, in view of the ravages of the disease, are willing to try the French sulphur cure, Mr. Flagg says:

He who would persuade a sick man to take medicine finds he has gained an important point when the patient is induced to admit that he is really ill. I think that to-day there are few who will deny that there are sick vines—very sick ones—on the hills of the Ohio, on the bluffs of the Missouri, on the shores and inlands of Lake Erie; sick Concords, disordered Delawares, suffering Iveses, diseased Nortons, and dead Catawbas. But how shall I go about it to establish the next point, namely, that there is a remedy at hand perfectly efficient to arrest the plague, and turn back our afflicted industry from the very gates of death?

I can point to the fact that the disease being a fungus, sulphur is scientifically known to destroy all kinds of fungi. I can refer to numerous instances, well known and often published, in which the same disease, appearing in green-houses, has been unfailingly cured by means of sulphur sprinkled on the hot pipes. I can relate how, during the same sickly season of 1869, I treated with sulphur my own vineyard of twelve-year-old Catawbas, in that doomed district, the Ohio Valley, and which had for the four preceding years been ravaged by the pest, and how I succeeded completely, as I knew I should, after what I had learned in Europe. Or I might cite other cases where, though success was somewhat less complete, yet sufficient was obtained to prove that sulphur has a marked specific power over the disease. But these cases, even if admitted and believed, are importunately met by others in which the same remedy has been tried and failed; that is to say, sulphur has been sprinkled, and yet the grapes have decayed.

I might appeal to the experience of European countries, where, during fourteen years, the sulphur cure has been their sole, and yet sufficient, reliance against the terrible oïdium which, during the three or four years of its first eruption, swept everything before it; but men will not easily believe in facts that are remote, and are averse to stretch their belief across an ocean. I am myself an example, for it was not until I had traveled through those countries that I really comprehended and believed what I had, nevertheless, often enough, through books, journals, and word of mouth, been credibly informed was true. And even there, even in France, before the panic-stricken cultivators would be induced to try the simple remedy, Marés, De la Vergne, and others were obliged to conduct experiments on a large scale, and through a series of years, in many different districts, under governmental auspices; and the latter had to publish, besides numerous articles in the journals, as many as thirteen separate pamphlet treatises; and, furthermore, to go about from commune to commune, and from one department to another, delivering lectures and holding discussions.

The vine disease in Europe is a vegetable fungus, which fastens to the surface of the different parts of the grape-vine. It is scientifically termed *erysiphe* more properly than *oïdium*, and is classified as a cryptogam of the family of *mucedinæ*. To the naked eye it appears only as a fine whitish dust, covering portions of the leaves, buds, stalks, fruit, or fruit stems. Its existence was first discovered in 1845, on the vines of a green-house in Margate, England, whence it soon found its way across the channel into France, and thence spread rapidly all over Europe, carrying swift destruction wherever it went, and exciting the utmost dismay. In common words, it is a fungus that causes all this trouble; and although in Europe it has several scientific names, Mr. Flagg throughout

his book gives it the common name of "mildew." Though this disease differs from our mildew, practically the distinction is not important, as sulphur destroys one fungus as well as another, and is the well-known specific for all diseases from fungus parasites.

The black rot in grapes is a severe affliction, which, Mr. Flagg says,

Results from bad drainage or bad ventilation, or both, in connection with peculiar conditions of the weather. It comes suddenly, with but few hours' warning at most. It appears at first in light brown spots, within which are often seen what looks like the gnawings of insects. These spots soon turn black—intense blue black to the eye, but, seen through a magnifier, dark brown. They are generally round in form, except on the leaves, where they are mostly angular and irregular. Spots of gray (or brown) rot begin at the base of the berry, where the stem joins it, but spots of black rot are scattered indiscriminately over the whole surface. A single one of them will often cover half the berry, causing it to cave in. Black rot is prone to seize upon the fruit-stem, into which it will eat, leaving hollows like pits of small-pox. The result of such destruction of the substance of the stem, where severe enough, is the subsequent decay of the one or more berries depending from it and nourished by it, with much the appearance of gray rot—which last rot I attribute to the workings of mildew on the same stems. This result will be quick or slow, according to the degree in which the stem is injured. Spots of black rot, whether large or small, usually become dotted with little raised pimples of blacker hue than the rest of the surface, visible to the naked eye, and easily felt with the finger. As decay progresses it causes the discolored parts to cave in, and takes various aspects like decay from any other cause.

On the leaf black rot works quite slowly, and so it does on the stalk; but on the fruit or fruit-stems, its ravages are rapidly accomplished. With a favorable change of weather it will go as quickly as it comes. This is seen where the state of the weather that has brought it on is followed by a clear, bright atmosphere and fair sky; then the spots take a brighter color, and seem to dry away, leaving harmless traces of rust-like appearance, sometimes covering the indented surface of scars, more or less deep, the subsequent effects of which will depend on their extent and the state of the atmosphere. The spots sometimes run together, or rather encroach upon each other; but otherwise they are apt to preserve their rounded and distinct shape. Sometimes they are bordered at the edges with a light shade of color. Black rot affects certain varieties more than others, and some grapes equally spotted with it resist its action better than others; notably the Concords, owing to their thick skins and tough leaves. Its consequences are immediate, as when the berries are directly attacked, or consequential, as when they rot or waste away through destruction of the fruit-stems, or loss of vigor to the whole plant from ravages on the stalks or leaves.

Black rot is worst on soils that are compact or damp, and not well drained and in badly-aired situations. Fogs, frequent rains, and heavy dews are the active causes which produce it. A long and wet spring will predispose to it vines, as well as other plants, so as to insure a fresh attack with each recurring rain or fog, or dew followed by a hot sun. It is of the same nature with, or rather it is the same thing as, those mold spots which similar conditions cause to appear on apples, pears, and other fruit, and the blackness which dyes the silk of corn in wet seasons. It is carbon. In France they name it *charbon*, (carbon,) and more scientifically *anthracnose*, which means black sickness, for they have long known it in France, and known no good of it either.

The effects of the black rot are seen in irregular patches of black, sometimes bordered with yellow, on the leaves; the young stems are injured, so that the affected part shrivels and falls off; it appears on the fruit only after it has attained some size, and in the shape of black spots, which harden and prevent its development. The *charbon* attacks the vines all of a sudden, and the injury is all at once; appearing on the grapes like brown spots or excoriations, as from insect bites; the attacks occur as often as the fog or dew is abruptly succeeded by sunshine; the same kind of weather that brings rust to wheat, and also spots pears and other fruit with black, causes *charbon* on grapes. Mr. Flagg says:

Many persons in this country, confounding black rot with the symptoms and effects of the fungus we call mildew, and searching in this rot for the causes of mildew, with a view to its cure, and having discovered beneath the skin of the afflicted part a fungus of quite another sort than that of the mildew developed there, and which, growing beneath the skin, is of course inaccessible to sulphur, have thence inferred that sulphur would not cure mildew.

Now this subcutaneous fungus is of no sort of consequence, either in relation to the

curability of the black rot itself, or the curability of the mildew. Marés tells us that whatever fruit is affected by *charbon*, whether it is a mulberry, a pear, or an apple, there is a fungus present, which, he further tells us, begins its life early enough to exist in those excoriations like the gnawings of insects, though it does not develop until several days later; that it is not the cause of the disease, but its effect; that it is very small and conical, and grows beneath the skin.

Black rot has afflicted the vineyards of Europe, more or less, for centuries, and yet the grape culture has survived its attacks; and it is not so serious a thing but that our culture can survive it. Neither is it so trifling a thing but that we should seek out and apply the proper means to prevent it. Those means are drainage and ventilation, as is well known in the south of France. Mr. Flagg adds:

My own vineyard being at the top of one of the six-hundred-feet Scioto County hills, and two hundred feet above the usual range of Ohio River fogs, and thus exceptionally well situated, I was able, by draining it, to keep the black rot so effectually in check during the season of 1869 that its ravages are hardly noticeable, except in an undrained corner, close to a thick wood, although in that year of 1869 this rot rioted throughout that valley. The corn silk turned black, as if dipped in ink, and every haystack looked as if covered with a pall; apples and pears also were discolored and distorted by it. I can well believe that for certain varieties there are vineyards in which, during seasons like that of 1869, the evil would be too inveterate to resist.

He states, as the reason why sulphur cure is not more practiced in America, the failure of experiments by those who did not clearly apprehend the distinction between black rot, on the one hand, and the gray rot and other decay consequent on attacks of mildew, on the other. Such persons may have applied sulphur enough to their vines, and yet their fruit has rotted; and seeing this they have abandoned the field in despair; whereas, had they persevered and closely observed, they would have learned in the end that, despite their efforts, black rot continued to work, even on grapes covered with sulphur dust, but that nothing else injurious had occurred; and would have found, when the season closed, that although they had lost more or less of their crop from the black sickness, the far more terrible white one, the fungus of evil, the dire cryptogam of the hateful family of *mucedinæ*, had not shown itself. Other causes of failure are the attenuations of sulphur, weakened by mixture with inefficacious substances; bad tools, as heavy sulphur bellows, which inspire laborers with disgust; and also ignorance of the rules and consequent want of precision in the practice of "sulphuring" the vines.

Newly-planted vines and new varieties will, for a limited time, do well anywhere, notwithstanding neglect and ill usage. Hence we hear, from time to time, of the wonderful productiveness of freshly-discovered grape districts, and especially of their immunity from disease; and doubtless the glowing accounts which come from one and another of the fields of operation are, to some degree, founded in reason. We shall for a long time, I hope, continue to hear of discoveries of more propitious soils, and more valuable grape plants. But whoever hopes, by traveling ever so far, or hybridizing ever so industriously, to escape from the ordinary conditions of labor and vigilance to which all kinds of cultivation of the products of the earth are subjected by universal law, will find himself mistaken. Undrained soils will sooner or later breed the black rot, greedy pruning will sooner or later exhaust the best vineyards, and the spores of mildew, ever present in the atmosphere, will in their own good time find out the vines they so much love to afflict.

In 1868 I visited some vineyards in a county into which grape culture had but lately been introduced, and where hardly anything but Concords was known. Passing from one beautiful field, where perfect health prevailed and the assurance of an eight hundred gallon crop to the acre gladdened the eye, for all was purpling for vintage time, and entering another adjoining it, I found disease to be playing havoc there. "Why is this?" inquired the owner. "The soil and exposure of both fields are the same, and the vines in both are Concords." "How old is the healthy field?" I asked. "Four years." "And the sickly one?" "Five." "Very well," said I, "see how your four-year-olds do when they get to be five years old." The next year there came bad news from that county, and the same year, 1869, came also bad news from the new vine district of Crooked Lake, which had previously been esteemed so healthy. Now a safer

place of refuge than the borders of Crooked Lake can hardly be imagined. The coldness of the climate is unpropitious to the development of mildew, and the decomposed shale in the soil seems to have a positive preventive power, owing to the sulphur it contains, and seems, besides, to have other elements which give strength, and strength resists all diseases. If such a region has had to succumb, it will be hard to find one that will long remain exempt.

Taking the Catawba as a sample, the most rosy reports we have yet heard from any of the new districts are fully equalled by those published by Mr. Longworth and others in the earlier days of their success in the Ohio valley. Yet what is the case to-day? Let all illusions be abandoned; let us look our foe closely in the face, feel his pulse, learn his symptoms, search out his causes and consequences, select the remedy, and faithfully administer it.

Mr. Flagg says he effectually saved his crops in 1869 by "sulphuring" his vines regularly once in every twenty days, beginning as soon as the shoots were two inches long and continuing until changes of color in August indicated that the ripening process had begun in the fruit, when it was out of danger. As regards the expense of "sulphuring," the luxuriant vines of Southern France require, on an average, eighty to one hundred pounds of flour of sulphur to the acre, and four to six days' labor, to put it on. The small and closely set vines of the neighborhood of Bordeaux require about fifty pounds, but need the same amount of labor. In this country the quantity needed would be about midway between the two, and the labor about the same. In France the finest and best sulphur costs 2¼ to 2½ cents a pound; in this country about twice as much. The finer the sulphur the further it will go. One can thus see that the probable expense of saving his vines from destruction is not very great.

Much loss and discouragement have come to American vine-growers from neglecting to drain. In Europe all soils not naturally dry are made so by draining or terracing. In commencing grape culture in this country, drainage was thought unnecessary, because the ground was trenched very deep, which so loosened the toughest clay that it did very well for a while; but in time it relapsed to its former condition, and was as bad as before. No clayey soil can, in the long run, grow healthy vines unless very thoroughly and carefully drained; and the owners of vineyards on such soil may as well abandon them at once if not prepared to make the needed expenditure. As a safeguard against black rot, draining is indispensable, and is the chief preventive of that disease.

Some varieties take the vine disease, as some will take the black rot, much more readily than others. The Catawba has been the worst sufferer, and the Isabella has escaped the best. The Catawba is worth saving, and has acquired a worse name than it deserves. It has had the misfortune to be the victim of all the mistakes of beginners in vine husbandry, and has been abandoned to the ravages of both mildew and rot till they have gained a certain foothold upon it; but Mr. Flagg is confident that it can be easily cured of mildew, however it may be with black rot. He adds:

If I should name the vine which I think best able to resist disease, and which, even if attacked, is most worthy of rescuing from its clutches, I would name the Norton's Virginia seedling, which, from its crystal-clear and garnet-red juice, full-bodied and rich, and from its "vinosity," "neat flavor," and delicate aroma, invited and received at the hands of the jury of the Paris Exposition of 1867 the highest mark awarded to any of the ninety samples of American wine which I had the honor to present for their tasting. As this vine puts forth at least ten days later and ripens at least ten days earlier than the Catawba, and has, at the same time, a surplus of sugar, it is adapted to a wide belt of our vine region, and is worthy of trial even in our most northern districts. Wherever planted, however, its fruit should be fully fermented on the skin to make a red and not a pink wine.

The book closes with suggestions on the expediency of "sulphuring" apple and other fruit trees to prevent the mildew that has afflicted and

disfigured the apples, pears, quinces, &c., for many years past. He says:

About the time of the appearance of the *oïdium* in Europe there came a crowd of other cryptogams, which alighted on apple, peach, quince, and apricot trees, as well as on clover, sainfoin, violets, roses, and many other plants. They all made themselves known by a whitish dust, the same to the naked eye as the *oïdium*, and worked similar evil effects; but none of them were identical with it, and it was found, on examination, that each species of plant had its own variety of cryptogam, and upon attempts being made to communicate to other plants that which fed on the vines, however near to it in kind, the attempts all failed. Nevertheless, each variety of cryptogam yielded readily to sulphur, and it was applied with great success to the fruit trees especially.

I thought I greatly improved the yield and quality of my apples last year by "sulphuring" the trees while in blossom. I hope others will try the remedy, as I also will, and more seriously the next time, and observe and report the results. One application would not, of course, test the full value of the system; and though on the more robust fruit of the tree destruction by disease will be less rapid than that on the vine, it would be no more than prudent to "sulphur" once at blossom time, and as often afterward as signs of disease should appear; or else to "sulphur" without regard to signs of disease, three times, somewhat following De la Vergne's thirty-day rule, as applied to the vine. My trees being young, I found no difficulty in blowing on the sulphur with bellows of ordinary size and shape; but for large trees the nozzle should be elongated by one or more joints of tin pipe, which was the expedient resorted to in France.

"TRY IT."

STATE REPORTS ON AGRICULTURE.

The annual reports of the State agricultural organizations of Maine, Massachusetts, Connecticut, Maryland, South Carolina, Ohio, Michigan, Wisconsin, Indiana, Iowa, Missouri, and Colorado for 1868 have been received, comprising all that have as yet been published, as far as is known to this Department. The discussions of the boards of agriculture and the essays, lectures, and reports of committees contain many facts and suggestions, of which the most important are given, comprising such results of actual experience as are interesting and valuable.

MAINE.

The thirteenth annual report of the secretary of the Maine State Board of Agriculture, S. L. Goodale, gives a comprehensive survey of the agriculture of the State, the annual address of Governor Chamberlain, and abstracts of the returns of twenty-four local societies.

CHANGE OF CLIMATE.—DESTRUCTION OF FORESTS.

From all parts of the State comes up the same complaint of the diminished volume of water in the streams, occasioned by clearing up the forests, and denuding the hills of trees. The snows are not so heavy nor so frequent as they were twenty to thirty years ago, and there is less rain in the summer. Many of the old trout streams of twenty years ago are now completely dry, and several parts of the State suffer more than formerly from drought. Snow covers and protects the ground with less regularity. A forest near the sea coast in any part of New England protects farms further inland from the chilly east winds. A bare hill gives no protection; the wind pours over it as water pours over a dam. If the hill is capped with trees the windy cascade will be broken into spray. Its violence is thus sensibly diminished.

The first settlers in the counties of Kennebec and Oxford raised good peaches in abundance. This fruit retired gradually from Maine, quit Southern New Hampshire, lingered for a time in Massachusetts, and has finally been driven from all New England, except some favored spots

where shelter has been provided. It is still retiring southward, under protest, and seems unable to give assurance of making a stand north of Mason and Dixon's line. The same causes materially affect the more hardy apple. Trees are longer in coming to the bearing state. The general crop of the State has greatly fallen off. Orchards with the bleakest aspect produce the least. In the last season, apple trees in Kennebec County, under perfect shelter, were loaded with fruit, while on the bleak hills acres of orchard failed to yield a supply for one family.

Calvin Chamberlain, in a lecture before the Board of Agriculture, urged the importance of staying the destruction of forests by farmers. The uses of wood for the operations of civilized man are manifold, and ever increasing. Railroads are enormous consumers. The sixty thousand miles now in use, or soon to be completed, demand an almost incalculable amount of wood. With two thousand five hundred ties or sleepers to the mile, these roads require one hundred and fifty millions; and these ties require renewal every five years. This vast number causes the destruction of nearly an equal number of trees, a tree generally making but one sleeper. The lumber used in fencing these roads, in building bridges, depots, and cars is quite an item to be added to the preceding figures. It is estimated that the distance run each day by trains on all the roads is three hundred and eight thousand miles. Each engine, with an ordinary train, consumes about one and three-fourths cord for every twenty-five miles. This gives a daily consumption of wood for this purpose alone of twenty-one thousand five hundred and sixty cords, or six and one-half million cords annually. Telegraph poles are a recent item in demand for trees. The sixty thousand miles of lines, at forty poles to the mile, require two million four hundred thousand poles, representing as many trees recently cut. These also decay, and require renewal. The mechanical industry of the country demands much wood and lumber. About half a million of artisans, enumerated in nearly a hundred trades, work wholly in wood,

The late civil war caused great destruction of wood for fuel, for fortifications, to hinder the movements of opposing forces, and to open the country for military movements. Sleepers from torn-up railroads, costly bridges and buildings were burned, the relaying and rebuilding of which demand a new supply.

Much land in Maine and other States, worth little for tillage by reason of rocks and other obstructions, has been cleared, which should have remained permanently in wood, in locations where the wood, if spared, would have secured a permanent value of $100 per acre. On every hand the waste of the forest goes on with a constant acceleration of speed. The cunning foresight of the Yankee seems to desert him when he takes the axe in hand. When we think of the increase of population, and look forward to the time when the number will be one hundred millions, then two hundred millions, what will be their condition? What proportion of that host will be poor? What will be their condition? We need not go far, nor peer into the future, to see the beginning of the end of all this. The increased price of fuel diminishes the comforts of the industrious poor, exposes their health, confines them to a mere defense of life by consuming a large share of their earnings, which else could have been used for education, for personal comforts, or the purchase of a home. A great increase in the price of labor hinders the erection of dwellings. The poor man labors years longer to obtain the means to build a house. The growth of cities is retarded by it. Small and uncomfortable tenements are built. Rents are higher. The high price of lumber adds to the expense of furniture.

In California the miner can find no wood for a lever or a pick handle better than a pine limb. The western half of our country produces no timber suitable to make a carriage, a wheelbarrow, or any kind of farm implements. All these are now supplied from the East. American farm implements are in great request all over Europe. Germany, in particular, buys all that reach there as soon as they are landed, and is ever calling for more. The superiority of our tools and machines, which is everywhere admitted, over those made in Europe, is mainly in the better quality of the timber that enters into their construction. For handles of rakes, hoes, shovels, for scythe-

snathes, for shafts and poles to carriages and harvesting machines, there is no other wood that in elasticity and strength is equal to the American ash. * * * Sheep and cattle should be kept out from an acre or two of pasturing so that the hard wood growth may live, as these animals feed off all such growth, and then no wood but that of a black or soft growth can attain much size.

Mr. Holmes, of Oxford County, estimates the cost of keeping eight sheep to be equal to that of one cow, or say forty sheep to five cows. He calculates on an annual increase of forty lambs, worth in the fall \$3 each, \$120; four pounds of wool per head, one hundred and sixty pounds, worth on an average the past eight years 56¼ cents, \$90; making \$210 income from forty sheep. The sheep must be well cared for to produce this result, and there is an allowance of more than ordinary success in raising lambs. Two and a half gallons of milk per cow from the middle of May to the middle of September would give one thousand five hundred gallons, which would make one thousand five hundred pounds of cheese, worth at the average price of the last eight years 16⅔ cents, \$250; one and a half gallons of milk per day from the middle of September to the middle of December would aggregate six hundred and seventy-five gallons; allowing three gallons to make a pound of butter, there would be two hundred and twenty-five pounds of butter, worth, at 30 cents per pound, \$67 50. Presuming each cow to have had a calf, which at six weeks of age has averaged \$8 for several years past, the gross income would be, calves, \$40; cheese, \$250; butter, \$67 50; total, \$357 50—a difference of \$147 50 in favor of the cows. There is more labor attending the dairy, which is compensated by the sour milk and whey during cheese-making; a great aid in keeping and fattening hogs. These hogs make valuable manure, if well supplied with muck, leaves, loam, weeds, &c., so that with the cows and hogs a greater quantity of manure is obtained than from sheep, enough, perhaps, with the pork from the hogs, to compensate for the extra labor of the dairy. With cows more manure is obtained to enrich the soil, and therefore more corn, potatoes, hay, &c., can be produced, and the farm be kept in a higher state of cultivation. Besides, the farmers of Maine have less to fear from the competition of the West in dairy products than in the production of wool. In the rough and mountainous pastures of the State, however, sheep are valuable as pioneers of the plow, reducing, in a few seasons, land full of briers and weeds to arable fields. They scale rough hillsides and glean food where implements of husbandry are useless, and invariably leave a pasture better for having been kept on it. As they are good renovators of worn-out ground, it is thought a pasture full-stocked with cows or other neat cattle, will support the same number of sheep, without detriment to either and with benefit to the pasture. Mr. Ayer, of Waldo, recommends a judicious stocking with cattle and sheep, alternating every year.

Calvin Chamberlain, of Piscataquis County, has grown the Alsike clover several years, and states that it is hardy and more permanent than red clover, retaining its hold many years. It throws out several stalks from one root, and should therefore be sown thin; it bears cropping by cattle well; it continues longer in condition to be cut as hay than almost any other forage plant; and is the best honey plant in the world, working-bees forsaking almost any flowers for a field of this clover. It should be sown on fields so smooth that a scythe or machine can cut low, as the Alsike, if of any great weight, is sure to lodge pretty flat.

The wheat crop of 1868, in Maine, was double that of the previous year, owing partly to the increased premiums offered by agricultural

societies, and partly to the absence of the midge, which pest has been both starved out and killed by its enemies of the insect species, the latter a fly smaller than the midge itself. A great impetus was given to wheat culture by the State bounty in 1840, and since that time large crops have been raised. The climate and other conditions are all favorable to its culture, and it is not considered an exhaustive crop. Every year the great wheat growing regions are receding further and further west, and in the same ratio the cost of transportation is increasing. The average yield in Maine is larger than that of any other section of New England, and, indeed, of some portions of the middle States. Joseph S. Hall, of Patten, raised 31½ bushels on an acre, on land upon which potatoes were raised the year previous; Hall Bagley, of Charleston, raised 23¾ bushels to the acre; John Bagley, of Corinth, 21½ bushels; and William Grinnell, of Exeter, 18 bushels to the acre. These are exceptional cases, however, the crop through the State ranging from 9 to 24 bushels per acre. The amount raised still falls far short of the demand for home consumption.

Potatoes are an important item, and form the principal export crop in the eastern part of the State. In the northern and western counties the rot prevailed, destroying nearly half the crop, though fortunately a larger average than usual was planted. The new seedlings, the Early Rose, Harrison, and Goodrich, have proved very productive, vigorous, and healthy. The Jackson whites are a favorite old variety. E. F. Crane, of Kenduskeag, raised 320 bushels on one acre; John Bagley, of Corinth, 272 bushels; and many other instances are given, averaging about 200 bushels to the acre, which found a ready market at 50 to 75 cents per bushel. The acreage devoted to potatoes in Maine is steadily increasing, now that the ravages of the rot have so materially declined. Notwithstanding the length of time, and the breadth of surface over which the cultivation of the potato has been extended, a wide diversity of opinion exists in regard to many points in its culture. Farmers whose conviction is the result of twenty years' experience and careful observation, confidently assert that small potatoes, and few of them, are followed by as good crops, and the growth of as large tubers as if large potatoes and more of them had been planted; others, fully as truthful and observing, are certain that the planting of small or cut tubers and few of them, as a general rule, will be followed by a meagre crop. Equal diversity of opinion prevails on other points. Unaccountable results not unfrequently follow all tillage operations, but the laws of nature are fixed and sure. The difficulty is, we are not always able to perceive all the circumstances and conditions which contribute to bring about a given result.

The State Agricultural Society resumed its annual exhibitions (which had been suspended during the war) at Portland, in October. The display was a complete success, the largest and most attractive ever held in the State, comprising nearly four thousand articles. There were over three hundred horses entered for premium, a far greater number than was ever present at any previous exhibition in Maine, if not in New England, showing a gratifying progress in the breeding of horses in the last ten years. Great attention is now paid to raising this noble animal. The climate and soil are favorable, and it is confidently expected that the old prestige will be regained. There were three hundred and twenty-five entries of neat stock, sheep, swine, and poultry, though the numbers in the last three classes were quite limited. As an evidence of the improvement that has taken place in the character and value of the neat stock of Maine since the first exhibition held in 1855, nearly all the ani-

mals exhibited in 1868 were full-bloods of different breeds. The agricultural implements, products of the dairy, fruit, flowers, paintings, household manufactures, &c., embracing a great variety of articles, presented a display of varied beauty and remarkable interest. The receipts were $12,656 05, nearly double the amount of any previous exhibition.

A successful feature of great interest, too often overlooked at the State exhibitions, was the evening meetings for the discussion of practical and important subjects, in which many of the best farmers of the State and from abroad took part. The principal topics discussed were "farm-crops—their insect foes, and how to destroy them;" "stock-breeding;" "how the farmers of Maine can best improve their farms;" "agricultural implements," &c. In the discussion on stock-breeding, T. S. Lang, of North Vassalboro', said that what forcing a calf or other young animal has, the first six months, especially the first three months, determined its subsequent value. Breeders should spare no pains nor expense in feed or care of the dam for four months before foaling, and for six months after, if she feeds her colt so long. While the bone is forming in the colt, give it all the food it will eat. The bone attachments thus become more positive, and such animals are less likely to meet with the trouble incident to those that are weak and under-fed, such as ringbones, spavins, curbs, &c. J. R. Richards, of Kentucky, who has imported from Europe and Arabia some of the finest horses in the world, also urged the necessity of feeding the mare and foal, that the growth of the colt may be as great as possible while the bone is forming. In raising fine specimens of neat stock in Europe, it is not unusual to give the milk of two or three cows, if they will take it.

S. F. Perley, of Naples, advocated the policy of each farmer having a specialty, and spoke favorably of raising hay as opposed to stock farming exclusively. Manures had better be bought and hay sold at the prices of the last few years, though near large towns the case may be different. Manures are better than fertilizers, although the latter should be used in part. J. M. Carpenter, of Pittston, however, considered good stock and its products worth more in the end than selling the hay. Rev. W. A. P. Dillingham, of Augusta, urged manuring farms from every available source, till they become of great richness and productiveness; and advised keeping hay to improve stock with, and using compost rather than commercial fertilizers. He considered fruit culture one of the best sources of profit. Colonel Lang considered fertilizers good, but composts better, and by breeding good stock the value is increased. Mr. Witherell, editor of the Boston Cultivator, indorsed Colonel Lang's doctrine, quoted Liebig in support of a rotation of crops, and opposed the idea of specialty in farming. Alluding to the raising of tobacco in Connecticut and western Massachusetts, he thought the profit of the tobacco crop far exceeded the cost of fertilizing the soil, and that the extra fertilizing required would leave the soil in better condition for farm crops. He considered it better to keep hay at home and feed it to cattle than to send it to England.

The State commissioners on the fisheries recommend a complete revision of the hundred and fifty laws relative to this subject, now on the statute book, which are of a very diverse character, and the appointment of a board of commissioners with plenary powers, who shall have a general supervision of the fisheries throughout the State, and a board of wardens for each river basin; also, suitable encouragement to all who may engage in the cultivation of fish; with several suggestions and limitations as to the times when fish may be taken. Two seasons have now been spent in preliminary examination, and the time has come for

the commencement of vigorous work in restoring the salmon, shad, and other sea fish to the rivers of the State. The first step is the construction of proper fishways. The northern States generally are moving in this matter; and with a wise and liberal policy there is no reason to doubt that the fisheries of Maine can be restored to something like their former productiveness.

MASSACHUSETTS.

The sixteenth annual report of the secretary of the State Board of Agriculture opens with a report of the commissioners on contagious diseases among cattle, giving the different theories of the Texas cattle disease, and recommending stringent laws to prevent the introduction of Texas cattle into the Western States between the months of March and November. During the other months it is thought that the traffic can be permitted with safety and advantage, whereby the western farmer may turn his rich fields of corn and grass into money, and the supply of beef be increased.

The value of the fruit crop of Massachusetts is estimated at over $2,000,000. J. F. C. Hyde, president of the Massachusetts Horticultural Society, recommends, for a succession of apples, the Williams, Red Astrachan, and early Sweet Bough for summer; the Gravenstein and Pumpkin Sweeting for baking, and Porter for fall; the Baldwin, Rhode Island Greening, Roxbury Russet, Golden Russet, Hubbardston Nonsuch, and Ladies' Sweeting, for winter. Of pears, the Madeline, Rosteizer, Brandywine, Beurre Giffard, and Clapp's Favorite, for summer; the Bartlett, Belle Lucrative, Abbott, Paradise d'Automne, Swan's Orange, Sheldon, Seckel, Marie Louise, Urbaniste, Beurre Bosc, and Beurre d'Anjou, for fall. Of this latter pear Mr. Hyde says, "All things considered, it is one of the most valuable sorts cultivated; large, good, and productive." Marshall P. Wilder, the distinguished pomologist, who is rarely at fault, after indorsing all the above varieties, says that "of the thousand kinds he has proved by personal inspection, the Beurre d'Anjou stands first on the list." He has now more than four hundred bearing trees of this variety, and finds no difficulty in selling his crop, which he finished up last year at $25 a barrel, for the New York market. The tree is as hardy as an oak, and thrives in dry and wet, and light and heavy soils. It is never killed nor cankered in winter, and in quality is all that can be desired. Mr. Wilder regards his introduction of this fruit, more than thirty years ago, as one of his most satisfactory horticultural achievements. For winter pears Mr. Hyde recommends Dana's Hovey, Lawrence, and Vicar of Winkfield. In raising pears for market purposes and profit only, not more than five or six varieties should be grown. For the last fifteen or twenty years, it has been difficult to raise the peach in Massachusetts; in sheltered places, however, they withstand a great degree of cold, and if a few are planted annually a crop may be hoped for once in three or four years. Cherry trees have been unfavorably affected by drought and black wart, which have brought the raising of this fruit into disrepute. Formerly the Black Tartarian cherry was sold for $3 to $4 per bushel; now they sell for $10 to $12. Excessive manuring kills the trees, which thrive best in good strong grass lands that are not wet. The best sorts for cultivation in Massachusetts are the May Duke, Black Tartarian, Black Heart, Downer, and Elton. The black wart and the curculio have driven the plum out of cultivation. Grape growing receives great attention, not as much for wine as for market purposes. The Concord, a native of Massachusetts, which stands the coldest winters and is free from mildew, is the favorite variety; the Hartford Prolific

and Rogers No. 4 are also extensively grown. In view of the progress that has been made in grape culture within twenty years, it is thought not improbable that a new variety may yet be produced that shall be as "hardy as the Concord, as good in quality as the Iona, as large and handsome as the Rogers No. 4, which will resist mildew of foliage and rot of fruit, and ripen a week or ten days earlier than the Hartford Prolific." Great attention is paid to the culture of small fruits, the demand and supply showing an astonishing increase. Thirty years ago the strawberry was grown to a small extent near Boston, and a few hundred boxes glutted the market. Now there are thousands of acres devoted to this delicious fruit, and car-load after car-load is shipped from New York, New Jersey, and Virginia.

Notwithstanding the increased culture, the demand for the strawberry at remunerative prices is far in excess of the supply. One town that in 1861 consumed two thousand four hundred boxes, at an average price of 17 cents per box, last year consumed eleven thousand boxes, at 25 cents. While the population of the place increased 40 per cent., the consumption of this fruit increased 350 per cent. Thousands have discovered in its use a cheap and wholesome luxury that is highly beneficial to their physical well-being. Its culture is rather more difficult than is generally imagined, owing to the action of frosts in winter, the cutworm in summer, and the frequent sharp, scorching drought while the fruit is ripening. A fair crop three years in five is as much as is generally realized. A. P. Slade, an extensive grower of the strawberry, thinks that too many plants to the acre are generally set, and money and labor thus expended that yield no adequate returns. He recommends that the rows be three and one-fourth feet apart, and the plants three feet apart in the rows; the runners trained lengthwise the rows, during the summer, say six to eight thousand plants to the acre; then if the cutworms occasionally destroy one, the rows can be trained in so as to fill the vacancy. Plants should be set as early as possible in the spring, after the ground is in suitable condition, and clean culture by hoeing every week or two is absolutely essential. Thus carefully attended the first year, nine-tenths of this labor will be saved in future years. One good crop only should be picked, and then the vines should be plowed under, as setting a new piece is less expensive than carrying over an old one. Where pistillate plants are used, every tenth row should be set with a staminate variety. The culture of the raspberry, blackberry, gooseberry, and currant is also rapidly increasing; and the cranberries of the hitherto unproductive sandy soils of Cape Cod have become a great source of wealth, bringing high prices in all markets. General Newhall considers it indispensable to secure good, thrifty trees; that they be grown on seedling stocks, instead of being grafted into root-cuttings; they thus grow faster, and live three or four times as long.

Great complaint is made of the adulteration of commercial fertilizers. Mr. Clift thinks there is no class in the community robbed and plundered as are the farmers by the manufacturers of fertilizers. In getting up a manure that will sell for $45 a ton, they take a fish guano worth $20, then mix with it charcoal, &c., making an article worth $25, which they sell at $45. Mr. Boise, of Blandford, has been so often swindled in buying these fertilizers that he condemns them all, and thinks money expended for them is generally capital thrown away. John A. Morton, of Hawley, expresses similar views; he formerly used superphosphate of lime, poudrette, &c., but considers them "humbugs, mostly played out." Lime and ashes and compost, with peat and manure, pay him well. E. L. Metcalf, of Franklin, had quite as much

contempt for the fertilizers now in the market, and thinks the money paid for them wasted. Ground bones, when they can be had pure from the mills, mixed with wood ashes, costing $30 per ton, or lime and salt, or plaster and salt, and ashes, are compounds highly recommended by Mr. Metcalf. Dr. James R. Nichols, a practical chemist, says that bones at $1 per one hundred pounds, broken up coarsely, so as to pack in a box or barrel, with good unleached ashes, pound per pound, afford the best and cheapest fertilizer known. Make a box, say a foot and a half deep, large enough to hold the bones and ashes, and in a few weeks after being mixed they will become disintegrated and ready for the field. He calls for legislative interference to stop "the rascality practiced by the bone-grinders and fertilizer-makers; and to make imposition in the matter of fertilizers a penal offense."

Mr. Clift makes the important suggestion that the Agricultural College educate farm managers, who shall thoroughly understand the business of farming from the beginning to the end, so that the thousands of men of capital in our cities, who have a taste for agriculture, can invest a proper amount of capital and find those who can manage their farms for them. There are thousands who have money enough who would cheerfully invest ten, fifteen, or twenty thousand dollars in a farm, if they could find intelligent managers who would run it so that they could make seven per cent. on it. A class of farmers is wanted who can join their skill and knowledge to the capital of the thousands of men in our cities who have pecuniary ability and inclination toward rural pursuits, but not the requisite knowledge for an independent management of farms. More capital as well as more knowledge is wanted in farming. The suggestion is also made that the State set apart a fund, to be loaned to young men who get started in farming, but who have not the necessary capital to make improvements; on the same plan that the British government is advancing loans to farmers for draining their lands, which is telling with such splendid results on English agriculture. Draining is much needed on perhaps half the land in Massachusetts. There are few farms that have not more or less of their area so wet that it will not pay to work in the present condition. If a young farmer can go to a government fund, as he can in England, and borrow money enough to drain the few acres that need it, giving the State security on his farm, which would rapidly improve in value, it would change the face of the Commonwealth, and increase immensely its wealth and taxable property. Two average farm crops on drained land generally pay the whole expense of draining.

Alexander Hyde, of Berkshire County, considers orchard grass one of the most luxuriant and nutritious for both grazing and hay. "It never says die. It is the first to furnish a bite for cattle in the spring, is but slightly affected by the droughts of summer, and continues growing till the severe cold of November locks up the source of its nourishment. When cut or grazed it starts up with the vigor of the fabled Hydra." It can be mowed in June and August, and in a few days is fit for grazing, if it is not desired to cut a third crop. If cut while in blossom cattle and horses are exceedingly fond of the hay and thrive upon it. Sheep will pass over other grasses to feed upon it. Even in Kentucky, where blue grass is generally considered the king of grasses, Mr. Saunders, of that State, admits that when grazed down, and the stock off, it will be ready for regrazing in less than half the time required for the blue grass; and in summer it will grow more in a day than the blue grass will grow in a week. Its inclination to grow in tussocks may be remedied by thorough pulverization of the soil and a

liberal allowance of seed, (at least two bushels to the acre,) and a slight harrowing in the spring where tussocks have become prominent, so as to make a smooth sod. It is best to sow other grasses with it, that the surface of the ground may be filled with roots, and all the resources of the soil brought into requisition. It likes a deep, rich soil.

Of Indian corn, of which our beef, pork, mutton, and poultry are made, the average product per acre is not more than twenty-five or thirty bushels, which average ought to be doubled. For the last twenty years there has been no annual increase in its production. If well manured, and a spoonful of homemade superphosphate is applied to each hill, and a handful of wood ashes sprinkled at weeding, and the soil is carefully stirred, a yield of seventy-five bushels per acre can be safely counted on. In harvesting it is best to cut the corn from the hill about the first of September, and stook it at once. It will thus give corn with less shrinkage and make better fodder, besides saving labor. Although the average yield per acre is low, there are exceptions. Jos. Silvia raised 109¼ bushels; George D. Cottle, 108½; Allen Lock, 102¼; Obed Nickerson, 89, and W. Mayhew, 82¼. All these cases were in Duke's County, an island off the bleak coast of Massachusetts. Alexander Hyde stated to the Hoosac Valley Agricultural Society that, notwithstanding its rugged soil, Massachusetts raised more bushels of corn to the acre than Illinois with its fertile prairies; and that no State in the Union raised so much corn per acre as bleak, mountainous Vermont. An acre of corn in New England means more than one hundred and sixty square rods of soil slightly scratched; it implies also manure and hard work.

The crop of potatoes returned as the product of 1865 was nearly 4,000,000 bushels. It ranked then as the third in the State in money value; grass and corn only taking precedence; as it has since received increased attention, it will now probably rank as the second. It is an important crop to the State, as the climate and soil are favorable and its bulkiness and cost of transportation prevent competition from the fertile prairies of the West. The average price at the farmers' doors in Massachusetts is now 75 cents per bushel, while the consumption is far greater than when the price was one-fourth of this sum. At present prices flour is cheaper than potatoes. The question of planting cut or uncut potatoes is still a mooted one. Tubers of medium size, cut lengthwise, leaving three or four eyes to each tuber, are recommended by Mr. Hyde; cut in this manner the vitality of the seed-end and the nourishment of the butt-end are secured. In cutting the potato crosswise the support which the butt is designed to give the seed end is lost.

The people of Duke's County having decided that the Ayrshire was best suited to their climate and wants, the agricultural society, in 1863, purchased six thoroughbred Ayrshire bulls, and some cows and heifers, and disposed of them to the farmers, binding the latter not to sell any of their stock off the island in less than five years. The consequence is that, instead of there not being "a valuable animal on the ground," as the delegate in 1862 reported, there are now to be seen the thoroughbred and grade Ayrshire on every part of the island, embracing as fine specimens as can be found in the State. Some of this stock has been taken to Berkshire County.

There are thirty county and local societies, whose receipts for the year were $128,830 15; amount paid out in premiums and other disbursements, $106,262 38; value of real estate and other property, $398,024 21; indebtedness, $103,194 42; permanent funds invested in United States bonds and other unquestionable securities, $296,220 91.

Liberal premiums are offered for the plantations of forest trees; that of the State Society being $1,000.

S. A. Merrill, of Danvers, in the summer of 1864 purchased fifteen acres of land that had been in grass for several years, and "was nearly run out." It was plowed in the fall, eight hundred feet by five of hot-beds were laid out, and fourteen acres of the land were planted, mostly with garden vegetables; one hundred pear trees were set out, and half an acre of land was reclaimed by draining. The latter had been so low and wet as to yield nothing, but it now bears sweet grasses at the rate of four tons per acre. The two years following the land was liberally manured with swamp mud, night soil, fish, and barnyard manure. In 1868 seventy-five cords of manure were spread on thirteen acres, three of which were planted with onions, one each with cabbage, beets, and onions, two with sage, two with melons and squashes, and the remainder with various vegetables. Four cows, five horses, and three or four hogs were kept. The land is now in the highest condition for large crops. The total product of his thirteen acres last year was $5,733 98.

Upward of two hundred pages of appendix are filled with essays on the pests of the farm, drainage, improvement of meadow and swamp lands, special or commercial fertilizers, orchards and fruits, hedges, forest trees, cranberry meadows, domestic wines, live stock, dairy products, poultry, addresses to county societies, &c., adding greatly to the value of the volume.

CONNECTICUT.

The annual report of the secretary of the Connecticut Board of Agriculture for 1868–'69 contains, besides the usual statistics, lectures by Professor Brewer, on old meadows and pastures; by Professor Gamgee, on the condition of pastures that produce diseases in animals; by Professor Johnson, on grasses and green fodder; and a report on commercial fertilizers; besides discussions and communications on subjects chiefly connected with grazing, a leading branch of farming in this State.

The subject of the grass lands of the State, their condition and capacity, and their importance as the basis of successful husbandry, were amply canvassed at the evening sessions of the board. Professor B. recommends a variety of grasses as an important element in the excellence of old pastures. On a given square yard, for example, a greater weight can be grown if there are several species mingled than if there is but one, and this mixed forage is more eagerly eaten by stock, and is more nutritious. Besides, where pastures are seeded down with several kinds some start up earlier in the spring, others hold on later in the fall, and all strive together for room in the summer. A firmer turf is also thus given to pastures. If we closely examine a new pasture, seeded with only one or two kinds of grass, we shall find the ground by no means fully covered; there are bare spots between the bunches of grass. These unoccupied spots will support a second species better than more plants of the first, because one will take from the soil what the other rejects. Even after a second and third kind are growing, there are yet bare places that may be used by still other kinds, and these do at last get in there until, finally, the ground is entirely covered, and a thick matted sod is produced, furnishing more and more nutritious forage for many years. In the best grazing districts of England it is thought that it takes forty or fifty years to get a good pasture; and many old lawns and pastures there are three or four times as old, whose firmly knit, velvety sod, filled with species of the most nutritious

grasses, accounts for the excellence of the butter, cheese, and flesh produced. Good pastures and grazing mitigate the evils that have resulted from stripping lands of their original forests. In northern and western Europe, where grazing is a leading branch of agriculture, the well-matted turf protects the hills from the ravages of the rains. The keeping of cattle furnishes a continual means of manuring, and thus the fertility of the soil is kept up, in fact is increased, until the most densely-populated regions of the civilized world are found there, and certainly the centers of the greatest wealth.

Pasturage and the keeping of cattle are the only means of furnishing the enormous amount of manure that is necessary to preserve indefinitely the fertility of the soil. Those portions of France where the condition of agriculture is the poorest is where there is the least pasturage, and where it is best is where pastures and the keeping of cattle furnish the means. A comparison of the systems of agriculture in our own land, contrasting the North with the South, presents the same results; the one of barn-yards, manures, and increasing wealth, the other of waste, exhaustion of soil, conquest of new lands, ending in poverty. The wealth of the North is based on northern agriculture, and if that wealth is maintained it must be through the manure heap, and this finds its source in the pastures and meadows of the land.

Irrigation, also, is a great renovator of pasture lands. It brings forward fattening grasses for cattle. On meadow lands in Connecticut, with sufficient drainage, the crops have been increased two, and even three fold. It is also destructive to the growth of weeds, the golden rod, ox-eye daisy, and most other pestiferous plants. Sheep are also useful in clearing out daisies, if allowed to feed the pastures down close in May or June, Throughout India irrigation is the only means of renovating the soil; wells are sunk on the farms for this purpose, and the water raised by machinery worked by oxen.

For purposes of soiling lucerne is an excellent auxiliary crop, as it can be cut five or six times in a season, and needs but little cultivation after the first year. It is a perennial, long-rooted plant, requiring a rich soil, with an annual top-dressing of lime, ashes, and barn-yard manure, and should be sown in drills fifteen to eighteen inches apart, and kept free from weeds. Orchard grass, for mowing or grazing, is highly recommended. It is ready for the scythe with clover, and after cutting it immediately springs up again. If fed closely, it furnishes a continual succulent pasturage through the season. Its habit of growing in tussocks or clumps can be prevented by harrowing the ground in early spring, so as to make a smooth sod. Alsike clover is considered superior to the common white clover as a pasture grass, it growing a foot high, and furnishing more feed. Bees prefer it also.

Ashes are considered the cheapest manure for improving pastures; from 50,000 to 75,000 bushels per annum have been used in one township six miles square in Connecticut, at a cost of 25 cents per bushel, with most satisfactory returns in the increased products of the farms; 200 bushels per acre have quadrupled the product. Plaster is extensively used in Litchfield County, with the best results. It is especially useful on clover, but is applicable to all crops on dry land; one or two bushels per acre often doubling the product of an old decayed pasture. It costs \$8 to \$9 per ton at the mills. Fattening cattle improve pastures, while milch cows impoverish them; and whenever a farmer feeds his stock highly his farm improves in fertility. The longer a meadow is laid down to grass with proper top-dressing, the better the hay will be to feed. The average time for cutting hay in Connecticut is thought to be at

least two weeks too late. This delay injures the quality of the first crop, and occasions a failure of the rowen or aftermath. Close mowing by scythe or machine is injurious generally, preventing any growth of aftermath. Moderate pasturing in the fall is beneficial to most meadows, as the rowen, if left on the field, affords a shelter for mice, and checks the young grass as it shoots up in the spring. Orchard grass and timothy should be cut when the principal stalks show their blossoms, or they become woody and but little better than straw. Corn, sown broadcast in drills, is a valuable substitute for helping out the grain crops, either for summer or winter use. The first sowing should be made early in June, which will be large enough to feed in August; the second, two or three weeks later; the first crop is the best for winter use, and may be well cured during warm weather. The southern and western varieties are preferred, as they furnish a large growth, and cattle appear to relish them as well as the sweet corn. Two bushels of seed corn per acre is sufficient; this affords a more perfect growth than when sown thick. Cutting hay and fodder is recommended on all accounts, as giving an economical control over the supply, security against waste, and the facility of mixing different kinds of food in such proportions as may be found best. Corn stalks, coarse hay, and straw may be fed to great advantage. Corn stalks well cured are thus made worth as much as the best hay, and one or two quarts of meal will make a bushel of cut straw equal to hay. Roots in this case are necessary as an appetizer, and to prevent constipation, and may take the place of grain. Opinions differ somewhat on the advantages of steamed food for milch cows. Some estimate the increase of milk or saving of fodder by steaming at fully one-third. The Saxons have a proverb, "the softer the food the more the milk." Warm drinks tend to produce milk. The same amount of grain, fed in a warm thin gruel will produce more milk and butter of richer quality than when used dry.

Although in a few towns the meadows are steadily declining in yield, from the increase of daisies and other weeds, neglect of manuring, and bad husbandry generally, they are more productive now than twenty-five years ago, as a rule, throughout the State. The reports from leading farmers show that care, with small expense, is improving the pastures.

The secretary closes his remarks with the question: Will the farmers still allow the "let alone system" to go on, or will each do what he can to help himself and save the State from barrenness?

The aggregate returns from the different agricultural societies of the State show the satisfactory condition of $20,319 20 receipts, against $16,386 86 disbursements; besides the possession of real and personal estate, valued at $40,125, with an indebtedness of $13,210.

MARYLAND.

The great change in the labor system of Maryland, brought about by the late war, induced the legislatures of 1866 and 1867 to take measures to promote immigration from Europe. The deficiency of agricultural labor led to a depression in the price of lands, and a department of labor and agriculture was established; an office was opened in Baltimore; pamphlets were distributed in Europe to furnish information on the resources and advantages for settlers in Maryland, and to remove some of the prejudices that had prevailed in reference to the former slave States. These labors seem to have been well-timed and serviceable. Mr. McPherson, superintendent of the new department, reports that out of 10,807 emigrants arriving in Baltimore in 1868, 1,802 were induced to remain in Maryland; and in 1869 a still larger propor-

tion, 3,627 out of 11,052. All of these were from Germany, except about 200. The demand for laborers of all classes, however, has far exceeded the supply, and good homes and employment have been promptly furnished to all who have accepted the mediation of the office. To facilitate the distribution of laborers, arrangements have been made with local steamboats and railroads for conveying immigrants sent from that office to various parts of the State at half price. It is, however, stated with regret, that notwithstanding the efforts made abroad, the total immigration to Baltimore has not increased. It is difficult to divert from New York the great stream of immigrants, where an excellent code of laws and regulations, built up on a long experience, exists for their protection.

Among other duties of the superintendent, he was directed to inquire concerning the undeveloped resources of the State, especially those within the limits of Chesapeake Bay and its tributaries. His investigations led to interesting results. The annual product of oysters is not less than 10,000,000 bushels, worth at first hands $5,000,000. The value of this crop, before it reaches the consumers, probably exceeds that of the coal product of the State, which amounted to about 2,000,000 tons the past year. A State tax of three cents per bushel on oysters is recommended, which small charge, it is thought, would not diminish the trade, being in fact paid by consumers, who are non-residents and found in every town and hamlet between the Chesapeake and the Pacific coast. It is feared that the oyster beds of Maryland, as now worked, are being rapidly destroyed by the harrow-like dredges that drag over the beds from September to June. Dredging should be restricted to the period between the 1st of November and the 1st of May, and the highest fines be imposed for dredging at night. There are nearly six hundred vessels, each with two dredges, now in this business, making twelve hundred harrows, dragged by vessels under full sail, over the beds, night and day, without regard to the size or condition of the oysters, grinding up and crushing out the life of a thousand young ones to every mature oyster that is taken. This dredging business in the Chesapeake, where a comfortable anchorage can be resorted to in a few minutes, when desired, is much safer and more remunerative than that of the cod and mackerel fishermen, who risk their lives and their all on the bleak coasts of New England and Newfoundland for months during the stormy season, many nights tossed on the ocean, with the sea breaking over them from stem to stern.

The extent of the oyster beds of Maryland is about three hundred and seventy-three square miles, which, under the administration of proper laws, would give employment to twenty thousand laborers in a few years. Besides the six hundred dredging vessels licensed, averaging twenty-three tons each, there are also two thousand canoes, which, on an average, take daily about five bushels each by tongs, for seven months in the year. This fleet in 1869 employed 6,885 men, independent of those engaged in the carrying trade, which would probably swell the number to between nine and ten thousand hands employed afloat in the oyster business. About $10,000 was imposed in fines last year for infringement of the oyster laws.

It is well known that on the coasts of France and England the oyster had been nearly destroyed and was becoming so rare as to disappear as an article of trade, and was only to be found on the tables of the rich. This condition exists in England at present; but in France, since 1859, owing to the investigations of the celebrated savant, M. Coste, the matter has been taken in hand by the government, and wholesome laws

have been enacted for the cultivation and protection of the oyster, and ship-loads of American oysters have been imported and planted along the coasts. This has led to the most satisfactory results, furnishing a bountiful supply, and giving employment to thousands of poor dwellers upon the sea-shores, who would otherwise have lived in poverty.

SOUTH CAROLINA.

After an interval of eight years the South Carolina Agricultural and Mechanical Society held a meeting at Columbia, on the 10th, 11th, and 12th of November, 1869. The opening address was made by the president, who, after alluding to the causes which had suspended the meetings of the society, and referring to the hopeful prospects of a grander march in material progress under the new order of things than they had ever before witnessed, directed attention to the rich mining and manufacturing resources of the State, which have been hitherto entirely neglected, and remarked that population is now the chief want in developing the wealth of South Carolina. The greatest hope is in attracting immigrants from Europe; in default of that, the encouragement of the immigration of the Asiatic was recommended as a blessing to both parties. Immigration from either of these sources is urged in view of the great wants of the State, and in no spirit of hostility to the freedmen. He would not exclude them from the broad field of labor, nor withhold from them the fruits of honest exertion.

John S. Green, from the committee on fertilizers, alludes to recently discovered beds of phosphates, in almost inexhaustible supply, near Charleston, which came just in time to meet the deficiency in supply and the high price of guano, and recommends the appointment of an agricultural chemist, with a sufficient salary to insure his undivided attention to the great agricultural interest of the State. In regard to the relative merits of nitrogenous and phosphatic manures, he says the proportions of each should vary according to the nature of the soil and the plant; for instance, where the ash of the cotton seed contains forty-six per cent. of phosphoric acid, and the ash of the plant twenty-five per cent., it is evident that a larger proportion of phosphatic manure should be applied to cotton than to corn and the cereals, the ashes of which indicate not half the amount of phosphoric acid necessary to their existence. Cotton seed will furnish a large supply of nitrogenous manures. The best results are obtained by expressing the oil from the seed and feeding the cake to the stock, or using it directly as a manure. Dr. Léconte says the oil, either in the seed or the cake, contributes nothing to its efficiency as a manure, but is rather a hindrance, as it retards decay; the cake is therefore greatly superior to the seed, and the more thoroughly the cake is pressed the better. Scientific analysis shows, also, that in this form of cake the use of cotton seed may largely replace the use of corn in feeding stock, and furnish at the same time a manure nearly half as valuable by weight as the best Peruvian guano.

Colonel E. S. Keitt says that within the last four years particular attention has been paid to selecting improved varieties of cotton seed. Cotton is improved by cultivating in the best manner, and then selecting from each stalk the largest, finest, and most perfectly-matured bolls, having regard also to the number of bolls on the plant, as well as the fineness and softness of the staple. By selecting the former he may produce a seed distinguished for its productiveness; by taking the latter the variety may have a high repute for the superior quality of its lint. With cotton at an average of 10 cents per pound, the State, for thirty years before the war, was rapidly increasing in wealth; and now, with

cotton at double that price, it is not probable that political differences and the transition state of labor can long arrest the march of the great laws of political economy. It is claimed that South Carolina has an advantage over all the other cotton States, from the fact that the short staple cotton is never affected by the boll-worm, caterpillar, &c.; the State is never overflowed by high water, and seldom fails to make good cotton crops. By proper cultivation and systematic manuring, two bales to the acre can be produced.

It is admitted that corn cannot be made a remunerative crop under the old system of plantation culture. But by deep breaking up, under-drainage on moist land, judicious manuring, and leaving the roots of the corn undisturbed after it begins to tassel, the most satisfactory results have been attained. More attention to this crop is recommended. Fat stock of all kinds would then give evidence of full barns, and the old adage would be verified, that "it takes corn to make cattle, and cattle to make corn."

T. W. Woodward states that the efforts at raising fish in South Carolina have generally been failures, which is not surprising, since the experiments have been conducted without system. The general practice has been the formation of a puddle of water somewhere, and the indiscriminate throwing in of all varieties of fish possible to be obtained, which is as absurd as to embark in sheep husbandry by procuring a flock of sheep and a pack of wolves to run upon the same pasturage. The ponds were too small, insufficient attention has been paid to feeding, varieties of fish the most antagonistic have been crowded together, and no attention has been paid to separating the larger and smaller fishes into different reservoirs. Nature must be aided in raising a crop of fish as well as any other crop. Young fish only, and those of the same size, should be kept in the same pond; and, with close attention paid to feeding them with proper food, thousands of tons of excellent food may be added to the resources of the State.

It is stated that Passmore & Wilhelm, of the sorghum works of Greenville, South Carolina, have been entirely successful in manufacturing syrup and sugar of superior quality from the black imphee, grown in the immediate neighborhood of their works.

John B. Moore calls attention to the advantage and necessity of improved mechanical appliances to agricultural pursuits in the State. Thousands of acres now lying waste, in noxious grasses and worthless weeds, could be turned into the most productive fertility by the introduction of more perfect and powerful implements of culture. For the last forty years, while the southern planters, by exclusive attention to the culture of cotton, grew rich beyond any parallel in history, they were "the best starved enlightened people the sun shone upon, not producing a tithe of the actual necessaries of southern life, corn bread, and bacon; while of the luxuries of intelligent farmers' life, as the produce of the dairy, the fruit orchard, the fattening pens, &c., they were totally ignorant." The real, though remote, reason for all this was the want of proper, thorough, and deep tillage for producing, and economical appliances for gathering crops, to be obtained only through the use of the most improved farming and labor-saving implements, instead of those venerable agricultural relics "which bore upon their fossil features the marks of many thousand years, one of the most important being the peculiar emblem of Time itself." Improved tillage, deeper plowing, and thorough manuring are recommended. "Commissioner Capron's assertion that $150,000,000 in increased production may be added to the annual value of the crops of the United States for every inch that

is added to the depth of tillage is within the bounds of reason; and, in the opinion of your committee, the calculation would be far more correct in its application to the South than to the North, where our long droughts and drier climate force our plants to penetrate deeper in search of moisture; and we confidently predict that we shall hear no more of disastrous droughts, and failure of the cereal and hay crops in the South, when the steam-plow shall have turned our land ten to twelve inches deep, and have pulverized it sixteen to eighteen inches; and no more complaints that we have no time to harvest these crops and prepare them for market, when the mowers and reapers, the horse-rakes and horse-forks shall have superseded the wooden-tooth hand-rake and the ancient scythe; and the steam threshing machine shall have taken the place of the hand flail, and of 'the ox that treadeth out the corn.'" As many of the implements brought from the North are of slight and unsuitable construction for the peculiar wants of southern agriculture, it is proposed that members of the society form a stock company to establish at Charleston or Columbia a manufactory of improved agricultural implements.

A committee was appointed to elaborate a scheme for the establishment of normal schools, to be located in some healthy and economical part of the State, where the necessary scientific education for developing its natural resources can be obtained. Colonel J. E. Calhoun, of Abbeville, has offered one thousand acres of land toward this object.

The sum of $10,000 was voted for the expenses of the next fair, $8,000 of which was subscribed on the spot by seventy-six individuals. The city of Columbia has also contributed $8,000 to the same object.

The appointment of a State geologist is recommended, who shall make a chemical analysis of all manures offered for sale, as well as a survey of the different counties. Upward of $1,000 are offered in premiums for the best crops raised on ten acres manured with the Wando fertilizer. An elaborate report on the necessity of scientific and practical education was made by Thomas G. Clemson, in which the subjects of irrigation, pisciculture, manures, metallurgy, physics, schools of design, hygiene, agricultural schools, &c., are discussed in an able manner. In his remarks on hygiene the curious fact is stated that Mr. Calhoun, when Secretary of War, caused a scientific examination to be made into the modes of preparing food in the army. The result was the abolishment of the frying pan, as making more victims than bullets.

OHIO.

The nineteenth annual State fair for 1868 was held in Toledo, in October, and was more of a success as an exhibition of the industrial and agricultural products of the State than it was financially. The receipts from all sources were $28,641 65; balance on hand at the beginning of the year, $19,177 93. Disbursements, $34,935 04; leaving a balance in the treasury of $12,884 54, besides the estimated value of the lumber in use at Toledo, $5,000. The late George W. Pollock bequeathed to the society $4,000, to be used in purchasing the improved American merino sheep, as nearly pure as possible, to be kept and bred by the Ohio State Board of Agriculture, and the annual product of the sheep sold at once, and the proceeds invested in the same manner; and so on annually as long as the Board shall exist. In case of its discontinuance, the fund is to be transferred to the governor of Ohio for the time being, in trust, for the purpose of advancing the cause of agriculture in the State.

The following exhibit is made up from the official figures of the assessors of the several counties of the State:

PRODUCTS.	1867.	1868.
Wheat, bushels	15,220,726	16,480,059
Rye, bushels	1,023,520	815,666
Buckwheat, bushels	590,294	562,256
Oats, bushels	18,534,772	19,058,852
Barley, bushels	1,604,226	815,788
Indian corn, bushels	63,865,102	76,725,288
Hay, tons	1,993,463	1,743,537
Clover hay, tons	286,806	254,895
Clover seed, bushels	147,876	47,635
Wool, pounds	24,844,601	22,940,479
Grapes, pounds	4,558,707	2,937,737
Wine, gallons	291,933	143,767
Sweet potatoes, bushels	11,365	148,268
Apples, bushels	9,404,642	11,637,515
Peaches, bushels	1,402,849	599,499
Flax fiber, pounds	10,523,876	12,032,392
Flax seed, bushels	736,517	620,092
Potatoes, bushels	5,794,797	7,449,247
Tobacco, pounds	11,589,355	17,398,198
Butter, pounds	34,833,604	37,005,378
Cheese, pounds	19,985,486	17,814,599
Sorghum sirup, gallons	1,255,807	2,004,055
Sorghum sugar, pounds	20,094	28,668
Maple sirup, gallons	339,444	311,191
Maple sugar, pounds	2,655,881	3,570,932
Pears, bushels	125,702	66,712
Pasturage, acres	4,218,710	3,963,097
Orchards, acres	340,925	342,212
Stone coal, bushels	46,703,886	55,264,392
Pig iron, tons	1,887,584	208,746
LIVE STOCK.		
Horses	698,909	704,578
Cattle	1,504,558	1,492,581
Mules	25,272	25,020
Sheep	7,622,495	6,272,640
Hogs	1,807,594	1,455,943
Dogs	176,807	184,102
Sheep killed by dogs	34,141	48,202
Sheep injured by dogs	19,416	22,725

In 1867, aggregate amount of injury to sheep by dogs, \$123,827 54; in 1868, aggregate amount of injury to sheep by dogs, \$130,713 46.

In view of the steady falling off in the wheat crop of the State, it was suggested in the discussions of the Board of Agriculture that large premiums should be offered for the greatest crop raised on five acres in 1870; and for the most practical essay on the causes of the injuries of wheat, and on the best rotation of crops. It was mentioned in the discussion that in 1840 the wheat crop averaged 18 bushels to the acre, while now it hardly exceeds 9 bushels. In 1851 the aggregate wheat crop exceeded 25,000,000 bushels; now it is less than 16,500,000. Colonel Innis, of Franklin County, thought that one of the causes of this decrease was the bleakness of the climate, produced by the prevalent north and north-west winds; and stated as an evidence that in Illinois, where they were planting out millions of trees, chiefly evergreens, and bestowing care and attention to their forests, the climate was improving,

while in Ohio the trees are being destroyed. Wherever they make a business of raising good wheat in Illinois, they have planted borders of some kind of trees. Formerly Ohio exported millions of bushels of wheat; it is doubtful if she now produces breadstuffs enough for her own population.

Indian corn reached its maximum crop in 1860, 91,588,704 bushels, with an acreage of 2,397,639; against 76,725,288 bushels in 1868, on 2,232,301 acres. It will be observed, also, that there is a falling off of about 200,000 bushels of rye from the crop of 1867.

In an essay on dairy husbandry, Anson Bartlet says that the first cheese factory in the United States was established at Rome, Oneida County, New York, in 1850. There are now seventy-two factories in Ohio, besides numerous others in the northern and western States and Canada, through the instrumentality of which immense improvement has been made, until now American factory cheese stands unrivaled in the markets of the world. The introduction of the factory system into Ohio has added seventy-five per cent. to the production of its cheese. In 1857 the total export of American cheese to Great Britain was but 4,000,000 pounds. The amount has steadily increased, till in 1867 it reached 55,000,000 pounds. The improvement in the quality of Ohio factory cheese has fully kept pace with that in New York and elsewhere; and in March, 1869, it was sold at a higher price than ever before. Farmers' families are saved by this system a vast amount of hard labor, and still realize as much net cash for their milk as if they made their cheese at home. Besides, the cheese-factory system is developing a class of cheese makers of superior skill, from the opportunities they possess for acquiring information, as well as the spirit of rivalry that exists between them. The total amount of cheese produced in Ohio in 1868 was 17,814,599 pounds. In Erie County, where no factories exist, and cheese is made in families on the old-fashioned plan, there has been a rapid decline in production from 57,354 pounds in 1860 to 7,045 pounds in 1867; proving that the large factory cheeses of other counties are superseding the small ones made by farmers at home. In Geauga County there are twenty factories that use the milk of over twelve thousand cows.

W. W. Rathbone, of Marietta, prefers the yellow Nansemond sweet potato, on account of its robust habit, its earliness, and especially over all red varieties, as its ripeness can be decided early in the season by the golden hue of the skin. The variety is also one of the sweetest. It thrives on the poorer class of soils, and is less exhausting than any known crop. Mr. Rathbone has raised it for fifteeen years on the same plat of land, without manuring, and with no diminution of yield. In fact, his fields grow richer from the annual burying of the tops plowed under, as a green manure, while digging the crop. He preserves all his crop from fifteen acres, the largest as well as the smallest tubers, in the most perfect condition through the winter, in houses built for the purpose and held to a certain temperature. The crop pays well as a market crop, and never fails on dry or well-drained surface land. The demand is unlimited, and in dry seasons, when other crops are short, this is largest and brings high prices. Set strong plants on moderately fertile, rolling land, on high ridges or hills, with good surface drainage, keep down the weeds, and success is certain. The crop for 1868 was 148,268 bushels.

The show of grapes at the annual exhibition was better than in former years, both in the number of good varieties and in the general appearance of the fruit. The crop for 1868 reached nearly 3,000,000 pounds, on 7,500 acres, and the amount of wine pressed was 143,767 gallons.

The largest vineyards are in the northern part of the State. In Ottawa County alone nearly half a million pounds were gathered, chiefly for shipment. Mr. Stevenson, of Sandusky County, raised about seven tons of Iona grapes, being the second crop.

The apple crop was a comparative failure, generally, throughout the State, and the "failure has not been confined to any particular location or quality of soil, to any particular culture, or to any particular variety of fruit or kind of seed." The causes are somewhat obscure, but are generally ascribed to the climatic changes resulting from the destruction of the forests and to the increased depredations of insects. If hogs are kept in orchards through the summer, they loosen the soil by rooting, and devour the immature fruit containing the larvæ as it falls, thus preventing the increase of insects. If sheep are turned in, say half a day at a time, twice a week, they also eat the fallen fruit and prevent the growth of sprouts, weeds, and bushes; but if suffered to remain too long at a time they may bark the trees. Possibly the deterioration of the soil by continual cropping has something to do with the unfruitfulness and decay of apple orchards.

The pear crop exceeded 60,000 bushels, but the ravages of the pear blight are so extensive and severe as to dishearten cultivators of this fruit in most localities. Still there are sufficient instances of success to induce considerable planting. A call being made at the exhibition for those present, having experience in pear culture, to name what they considered the three best varieties for standards, and as many for dwarfs, it is a striking fact that of the eighteen cultivators who gave an opinion every one included the Bartlett in the list of the standards, and the Duchesse d'Angoulême among the dwarfs.

The peach crop for 1868 reached nearly 600,000 bushels, against 1,400,000 the previous year. It fails, on an average, one year in four. It is largely raised in Southern Ohio for shipment to the Atlantic markets, some growers having plantations of ten thousand trees. Their attention is confined to a few varieties that ripen in succession. Trees are planted twenty feet apart, and the branches and tops are cut off. The land is cultivated three years in corn. Injury from borers is prevented by hilling up the trees and digging the worms out with a knife. In shipping peaches, good new boxes of nice, smooth pine should be used, and the fruit well selected and assorted. The same quality of fruit packed in old boxes is frequently forced off at half price. Hale's Early, Crawford's Early, Large Early York, Oldmixon Freestone, Crawford's Late, Heath Freestone, Smock Freestone, Red Rareripe, Kensington, Oldmixon Clingstone, and Heath Clingstone are varieties recommended for a succession. Hale's Early and other white-fleshed early varieties are apt to rot, if the weather is wet and hot about the time of ripening.

The curculio is master of the situation in regard to plums, particularly in the country, where the fruit is universally destroyed by this insect. In some thickly-settled villages in Eastern Ohio, where every lot contains more or less trees, an abundant crop was raised. This destructive insect is partial to country life. The most promising remedy seems to be syringing the trees frequently with coal-tar water for four or five weeks from the time of blossoming. As a preventive, it is urged to let hogs have the range of plum orchards, when practicable, to eat the fallen fruit, which contains the eggs for the next generation of insects.

A new method of preserving fruits has been introduced in Northern Ohio, which, it is thought, may supersede the old mode of canning; that is, by treating the fruits with sulphurous acid gas before sealing. This gas permeates the fruit and hardens the tissues, so that it does not break

down in scalding and steaming. No canning liquid or powder is used. It is much cheaper than canning. It is not generally known that the tin cans frequently cost much more than their contents, and are of no great value after being once used. Tomatoes, for instance, cost only one-fourth as much as the tin cans, and in glass jars the disproportion is still greater. By this new process stone-ware jars are used, from which the fruit can be taken as wanted, without endangering that which remains, as it is not injured by atmospheric influences. The jars suffer no injury from the fruit, and last for years. If fruit can be preserved so as to be sold at moderate prices, the demand would be immeasurably increased. More than ten thousand quarts of fruit were put up in this way by one firm in Norwalk, Ohio, the superior quality of which over the old process was generally remarked.

MICHIGAN.

Sanford Howard, secretary of the Michigan State Board of Agriculture, reports the State Agricultural College to be in a satisfactory condition. The number of students, eighty-two, is quite as many as can be accommodated with the present buildings. Sixty, or three-fourths of the whole number, are sons of farmers. Their conduct has been altogether praiseworthy. They are required to labor on the farm, garden, or at mechanical work a certain portion of the day; and, with their experience amid good cultivation, good implements and machines, improved breeds of cattle, sheep, and pigs, they can hardly fail to leave the institution with well-trained minds and skilled heads, and thus become good farmers. In the management of the college farm its use as a means of instruction has been kept prominently in view. Its receipts were $6,009 25; expenditures, $4,795 15—leaving a profit of $1,214 10, besides many improvements in the groves and rough and uneven grounds about the college buildings. Complaint, however, is made by the president of the State Agricultural Society that the education of the students does not sufficiently inspire them with the nobility of the farmer's occupation, as well as its profits, which, he thinks, is apparent from the fact that not more than one out of four of the young men who graduate there embark in agricultural pursuits after leaving school.

R. F. Johnstone, secretary, reports the financial condition of the State society as satisfactory. Its funds, at the beginning of the year, were $7,304 40; received at the annual fair, $12,013 52; paid out for premiums, $14,819 90; invested in normal school building for board of education, $3,250; buildings, rents due, &c., $13,487 24; available assets of the society January 1, 1869, $14,655 27. The annual fair was not a great success, as it was held at a time that interfered with exhibitions in the neighboring States, and when farmers were busy in sowing their winter wheat. In the divisions of horses, implements, and machinery, however, the exhibition was never excelled. There was also a larger number than usual of exhibitors of long-wooled sheep from Canada. The urgent demand for the finer kinds of long-wooled fleeces is attracting the attention of farmers. The wool produced by the Leicester breed is most in request from its softness, gloss, and texture. In horses there was a marked improvement, and at no previous exhibition has there been so fine a show of young horses possessing the best qualities of stock. In improved breeds of cattle the State is still deficient, and is far from having as large a stock of cattle in proportion to its tillable lands as there should be; statistics showing that there are not so many cattle kept in the State in proportion to its population and tillable lands as there were ten years ago. The production of pork has

hardly kept pace with the increase of consumption. The high prices in all our markets justify more attention to the breeding of swine, and no domestic animals give a quicker return for care and intelligent selection in breeding. The exhibition and trials of agricultural implements and machinery were very satisfactory. The season was unfavorable for fruit generally. Only one farm was entered for premium. Among the specialties at the exhibition the woolen fabrics from the new mills recently started in the State attracted great attention.

Entomology, or the science of insects, involving so much of the beautiful and marvelous, and possessing so much economic importance, receives laudable attention in this State.

The destruction of forests and of insectivorous birds and animals has destroyed the original balance in nature, and left the insects greatly in excess of the native vegetation. Millions of dollars' worth of grain and fruit are thus annually destroyed, of which the devastations by the Hessian fly and wheat-midge afford melancholy proofs. That merciless forager, the Colorado potato beetle, (*Doryphora decem-lineata,*) has not spread or made much progress in the State. The only efficient remedy discovered is hand-picking; fowls prefer a different diet. The 17-year locust appeared in the southern counties, but without doing much damage. The oak-tree caterpillar (*Dryocampa senatoria*) has become fearfully numerous along the Michigan Central railroad. For three years past the oaks near Kalamazoo have been entirely denuded of their leaves, and nearly all the trees first attacked have died. The curious fact has been noticed at the agricultural college that the pupæ of the tomato worm are destroyed in great numbers by skunks, which draw them from the ground among the tomato plants. The codling moth (*Carpocapsa pomonella*) has become a great nuisance in the apple orchards. The best remedy is to feed the windfalls which contain the larvæ of the insects to the hogs as fast as they fall, and before the larvæ escape from the apples into the ground. The most troublesome insect at present, however, in Michigan, is the oystershell bark-louse, (*Aspidiotus conchiformis* of Gmelin.) Washing the trees through the summer with lye, tobacco water, or soap suds is frequently efficacious, but is not always to be relied on, unless applied just after the insects have been hatched; kerosene will kill any insect, or the vitality of any egg that it touches.

Reports from county societies state that increased attention is being paid to the culture of fruit; orchards and vineyards have been established, many of which are quite extensive. In Spring Lake and its immediate vicinity, not exceeding four miles from any point in the village, although not over five per cent. of what is planted has come into bearing, the sales of fruit last year exceeded $37,000. Of grapes, the Concord and Delaware are the most extensively planted, the former taking the lead of all varieties on account of its hardy character and productiveness. Next to the peach, the grape will become the leading branch of fruit culture along the lake shore. Peaches on high grounds seemed to escape the frosts better than those on low lands; and those planted where water could stand about their roots were almost always badly injured. Trees carefully budded in the fall, if the buds are not swollen by warm weather at that season, will stand the cold better, and the buds will live even if the mercury sinks as low as 15° below zero; but if buds are swollen in the fall they will not stand cold lower than 6° below zero. To a complaint that trees large enough to bear continue barren for years, some members thought this might arise from the custom of nurserymen budding from the trimmings of small trees

in the nursery; others thought that buds or cions inserted in a young tree will grow to wood, making the tree, but if buds were inserted in a limb of bearing age, they would grow into fruit spurs, provided the limb is left whole. Two year old trees are considered the best for transplanting, as the fibrous roots will all be preserved, a proper head can be formed, and in ten years after planting the tree will be as much advanced as one started at four years old.

The legislature has enacted several laws of immediate interest to farmers, among which is one to prevent the passage of Texas cattle through the State between the 1st of March and the 1st of November; others to provide that dry packing barrels for fruit, roots and vegetables, shall contain two and a half bushels; to prevent trespasses upon cranberry marshes; relative to draining swamps, marshes, and other low lands; to protect vineyards; and one authorizing counties to raise taxes for the benefit of agricultural societies, "providing that no horse-racing is allowed at the fairs held by such societies."

WISCONSIN.

The Wisconsin Agricultural Society, after a lapse of eight years, has issued another well-filled volume, which comprises a condensed account of the transactions of the society from 1861 to 1869; the report of the commission to the Universal Exposition at Paris, and the proceedings of the State Horticultural Society from 1864 to 1868, inclusive. The secretary of the society, J. W. Hoyt, makes a general report on the present condition of agriculture in the State, which is full of valuable information and suggestions. Under the stimulus of high prices, and the withdrawal of so many men during the war, farmers paid undue attention to the culture of wheat, as the best paying crop for those times, but its continuous cultivation has led to impoverishment of the soil. There is now, however, steady progress in systematic farming. The importance of drainage, with reference to the general health, the improvement of the soil, and the quantity and quality of the crops, is becoming more obvious. The deteriorating effects of some crops and the ameliorating influence of others have led farmers to study more carefully the adaptation of grain to particular soils and conditions, and to admit that a rotation of crops and a proper manuring of lands are based on science and common sense.

The old rule of raising wheat universally, year after year, is giving way to a more rational practice; crops are more diversified; and clover, the great ameliorator of soils, is now used in the recuperation of thousands of partially exhausted fields. Wheat, however, so long the leading crop of the State, has hardly lost its prestige, 25,000,000 bushels of it having been raised in one year. The ravages of its enemy, the chinch bug, (*Micropus leucopterus* of Say,) were extensive in 1864, 1865, and 1866, but the extremely cold winters that succeeded, or other natural causes, have nearly exterminated it.

Although potatoes have generally escaped the rot, they have suffered from the western potatoe bug, which seems to be steadily making its way eastward.

Sorghum became an important crop during the war, and in 1866, its product of sirup reached in value half a million dollars; but as the prices of southern and foreign sugar declined, sorghum could no longer compete with the sugar cane of the South. Still its introduction was a great blessing to the West. During the war it formed a very fair substitute for the saccharine supply of the Gulf States. Its cultivation will not be abandoned, even in the West, as many have acquired a

fondness for its peculiar flavor, and will raise enough for their own use.

For the last four or five years the cultivation of hops has had an extraordinary run, owing to the repeated failures of the crop in the Atlantic States, from the ravages of its insect foes. The climate and soil being admirably adapted to its healthy growth, in 1866 the business of planting and poling began and raged like an epidemic; the next year the excitement extended over the whole State, completely revolutionizing its agriculture; and in Sauk county alone the crops exceeded 4,000,000 pounds, with a cash valuation of over $2,500,000. But the business has greatly declined in the past three years, both from falling prices and the depredations of the hop insect.

The manufacture of agricultural implements has made considerable advance within a few years. A single firm in Madison has sold six thousand mowers and reapers in one year. The large cereal crops now grown compel farmers, from motives of economy, to throw aside their old implements. Not only mowers and reapers, but grain drills, sulky cultivators, revolving steel-toothed rakes, horse hay forks, and numerous other inventions of great value are sold in incredible numbers, demonstrating the thrift and enterprise of the farmers, as well as the incalculable benefits conferred upon agriculture by the mechanic arts.

Thorough-bred animals of every class are becoming more common, and their influence upon the native stock is marked. Farmers hope to rival Vermont and Michigan in breeding fine horses and sheep, Kentucky in cattle, and perhaps New York in the dairy business. Of horses, Wisconsin can already boast of some of the finest specimens in the West, and the number is being steadily increased by the constant production and the importation of superior thorough-breds. Cattle breeding has not received its proper share of attention, owing partly to the great interest concentrated in wool-growing. The Durhams and Devons are the favorite breeds, the former for beef and the latter for work; there are also a few small herds of Alderneys and Ayrshires. The establishment of cheese factories in various parts of the State has resulted in a more uniform product, and of better average quality to begin with, with promise of greater improvement, through more careful study of the scientific principles involved. Such has been the success of these factories in New England and the Middle and Western States, that the product of cheese has increased from 6,500,000 pounds in 1857, to 100,000,000 in 1867, resulting also in the manufacture of an article fit to be exported, which could not be said of the four or five millions of pounds shipped twenty or thirty years ago. When butter-making comes to have a part in the plan of these associated dairies, its average quality and quantity will be improved in the same ratio.

The undulating, and in some instances hilly surface and pure, dry atmosphere of Wisconsin are admirably adapted to sheep husbandry; and a remarkable increase in the value of sheep and wool is noticed. In 1860 the amount of wool produced was 915,073 pounds, valued at $331,147; in 1865, 2,584,019 pounds; value, $1,916,248. Wool must always be a staple crop, and eventually the bulk of its production will fall to those portions of the country best endowed by nature for this purpose. The cashmere goats introduced into the United States twenty years since (originally but nine animals, two males and seven females) have multiplied until their progeny are found in nearly every State, Wisconsin included. The great value of their white, wavy, silk-like fleece renders this breed a very desirable acquisition. Their adaptability to this climate, colder than their native habitat, is, perhaps, not

wholly settled; still, with good care, they have passed satisfactorily through several seasons in Wisconsin and other equally cold States.

The climate of Wisconsin has generally been considered unpropitious for the culture of the vine, but with care and painstaking all the hardy grapes of the Atlantic States seem to thrive. The Concord is the favorite variety. The Delaware stands next in general estimation. There is little or no trouble from any of the usual diseases of the vine, which cultivators consider another illustration of the beautiful law of compensation that always exists in nature. What Wisconsin lacks in length of season is made up in soil, while the latter is suited to the character of the climate. The climate inflicts less injury on their grape vines than on anything else grown in their orchards or gardens. In preparing the soil for grape-growing it should be merely broken up twenty to twenty-four inches deep, no manure being necessary till the second or third year, when a slight top-dressing may be applied. Many kinds of apples, pears, plums, and smaller fruits thrive well, and are now raised in sufficient quantities for the home demand. But a longer experience is necessary before making up lists of the fruits best adapted to the State. The legislature has passed several judicious laws relative to the planting and preservation of fruit trees, and to encourage the planting and growth of forest trées in the form of tree-belts. Where the owner of five acres plants one-fifth of his land in forest trees, in the form of tree-belts as a protection against severe winds, the land so occupied is exempt from taxation till the trees reach the height or twelve feet, after which the owner is to receive an annual bounty of two dollars per acre. The width of the belt, the trees of which it is to be composed, and other details, are prescribed in the act.

The interests of mining, lumbering, manufacturing, education, &c., are amply discussed. Wisconsin exceeds all the other States in the production of lead, and is second to but one State in the production of iron ore. The value of her lumber and shingles exceeds $10,000,000 per annum; of agricultural implements and machinery, $4,000,000. The value of her manufactures is estimated at $40,000,000.

The financial condition of the State society is stated to be satisfactory. The receipts for 1868 were $12,857 64; disbursements, $12,500 54. The number of life members, at a subscription of $20 each, exceeds five hundred.

INDIANA.

The tenth annual report of the Indiana State Board of Agriculture, for 1868, contains the proceedings of the board, abstracts of the reports of many of the local societies of the State, the proceedings, correspondence, and discussions of the American Convention of Cattle Commissioners, held at Springfield, Illinois, besides essays on various subjects connected with farming. The financial condition of the board is quite satisfactory; receipts, $36,775 93; disbursements, $22,046 83; leaving a balance in the treasury of $14,729 10. The board is entirely out of debt, and owns the valuable fair grounds in Indianapolis, comprising thirty-six acres, with buildings. The fair in 1868 was a success, upward of fifty-two thousand admission tickets having been sold. The exhibition of live stock was good, notwithstanding the prevalence of the cattle disease in the State. The mechanical department was never surpassed in the West; fully four acres being densely covered with saw-mills, reapers, mowers, threshers, cultivators, separators, and other mechanical and farming implements. The exhibition of fruits was excellent, but that of farm products fell short of that of the previous year.

R. T. Brown, in an essay on Indian corn and wheat recommends that seed corn be selected in the fall, before the crop is gathered. A large stalk, thick rather than tall, bearing two well-developed ears, the grains well set in regular rows on the cob, and well filled out to the end of the ear, should govern the selection. By this course the ears that ripen earliest can be chosen, and the crop be thus improved in regard to the period of ripening.

More stalks of corn, and probably more bushels, may be raised on an acre by drilling the seed in rows five feet apart, allowing about six inches to the stalk in the row, than by the usual method of planting in hills; but as drilled corn can be plowed in only one direction, it will require more hard labor in its cultivation, and at the present high price of labor it is best to plant in hills, four stalks to the hill, four feet apart for the larger sorts, and for the smaller kinds three stalks to the hill, three feet apart. Grain dealers say that pure white and pure yellow varieties have a much higher market value than the mixed sorts. Pure white varieties, it is thought, produce more to the acre. No strictly merchantable white corn can be grown on a red cob. Corn should be planted either so early that it will be well up before the May rains, or, still better, be delayed until after these rains, as it will not sprout if the temperature of the ground is below 60°; if lower than that, with much moisture, the corn will rot. The large sugar corn introduced through the Department of Agriculture bids fair to be a valuable acquisition where the crop is fed to cattle, being early, of medium size, and yields one to four ears to the stalk. Cattle prefer it to other corn; it possesses a larger proportion of oil and other fattening qualities; the fodder is also preferred. As a corn-producing State, Indiana stood the fifth in 1840, the fourth in 1850 and 1860, and in 1867 it was the second, the crop exceeding 80,000,000 bushels. L. B. Brown obtained the premium of $10 for the best half bushel of spring wheat; the variety was the Arnautka, a hard spring wheat introduced by the Department of Agriculture; it was sown in drills, March 20, about three pecks; cost of producing the crop, including the seed, $6; yield, thirty-three and one-half bushels per acre. Spring wheat is but little cultivated in Indiana, but farther west it is largely grown in the prairie regions. A white wheat, originally received from the Department of Agriculture, attracted special attention at the exhibition, and fifty bushels for seed were sold by sample. The white Tappahannock, also exhibited, was in great demand for seed. Though wheat is cultivated over a wide belt of the earth's surface, it attains its highest perfection only under certain well-defined conditions of climate. It will endure a very low winter temperature without injury, if that temperature is uniform. Frequent and sudden changes from heat to cold, or worse, from cold to heat, will soon kill it. Snow furnishes the most perfect protection, and where the surface is covered with snow in the winter will be found the best wheat climate, other things being equal. From the time the head begins to appear till it is harvested, wheat demands cool, dry weather; and the cool summers of England have much to do in producing their premium crops of fifty or sixty bushels per acre; to the same cause California and Oregon owe their large wheat crops. It is a great error to permit wheat to become too ripe before it is cut. As soon as the milk has fairly disappeared from the grain, and while it is yet soft, it should be harvested; the grain will thus retain its plumpness, the bran will be thinner, and the flour fairer and sweeter.

Dr. W. B. Fletcher, of Indianapolis, furnishes valuable observations on the Texas cattle plague. After describing the ravages of this dis-

ease, where native cattle had been pastured after Texas droves, and had drunk of streams below those pastures, he says, the cattle of John Austin, who keeps a dairy of thirty cows, that occupied an adjoining pasture, but did not drink of the same water, escaped. From the general character of the cases coming under his observation, Dr. Fletcher's conclusions are, that these cattle became diseased from drinking water in which the Texas cattle had been standing; the cattle of Mr. Austin had access to the Texas cattle over the fence, but not by the water or grass, and no one of his dairy stock was affected. Dr. Fletcher believes the disease to be a fever arising from a blood poison conveyed to the water or herbage by Texas cattle, and from thence to our native stock; for it is one thing constantly noticed that our stock must go upon the same pasture, road, or water as the Texas cattle, to be infected. Home-bred animals licking the Texas cattle over a fence and rubbing upon the same seem not to be infected. In relation to treatment, his own convictions are that the "disease demands the same care and attention that a human being would require when stricken down with some pernicious fever. The animal should be removed from others, and be well sheltered, and food and water should be administered at regular intervals, for if this is not done, the animal must perish from exhaustion by starvation. Tonic medicines might be given with the food, and nature, thus supported, might have a chance to struggle through the dire calamity."

The aggregate of the apple crop for 1867 exceeded 9,000,000 bushels; peaches 1,400,000 bushels; the commercial value of these two orchard fruits exceeding $8,000,000. Grapes, pears, quinces, &c., add largely to the value of the fruit crop of the State. These amounts will be largely increased as a more correct knowledge of the best methods of cultivating orchards and destroying the insect enemies of the fruit shall stimulate the grower to put forth his best efforts. The commercial value ot the apple crop of the little county of Lake, in the extreme north-west corner of the State, in 1868, was at least $100,000.

IOWA.

Dr. J. M. Shaffer, secretary of the State Agricultural Society, calls attention to the imperative necessity of supplying the want of timber by artificial groves. The legislature has exempted from taxation for ten years to the amount of $100 property of any person who will cultivate an acre of forest trees for timber, and to the amount of $500 of all who, within the year, will cultivate an acre of fruit trees; also the same amount for every mile of shade trees planted along any highway. The good results of this law are already visible in almost every county.

The Colorado potato beetle, the great pest of western potato fields, was less destructive than in some previous years; but another enemy, the old-fashioned blistering beetle, (*Lytta vittata*,) committed such ravages in the southern and south-eastern counties of the State as to occasion almost a total failure of the potato crop there. So destructive is this beetle that in less than twenty-four hours after it makes its appearance in a potato field there is nothing to be seen but rows of stalks stripped of every vestige of foliage, and in spite of favorable rains and sunshine to recuperate the wasted energies of the plant, the farmer finds at harvest time nothing left for his labors. The "hateful grasshopper," (*Caloptenus spretus*, Walsh,) from the Rocky Mountains, was also very destructive to the grain, potato, and fruit crops in many parts of the State. The loss of wheat alone, by its ravages, is estimated at half a million bushels.

Complaint is made that farmers are too indifferent to the introduction of improved breeds of cattle, and are too easily satisfied with common scrub stock. Although a few persons have introduced thorough-bred animals, and have taken proper care in rearing them, a majority of farmers are content to follow the old routine. Stock receive little attention in winter, but eke out their living on prairie pasture and prairie hay, with little or no grain. At the end of three years the steer is put in market, and much of his price is considered clear gain. The legislature has passed an act to prevent the importation of Texan or Southern cattle, and the spread of the so-called Texan or splenic fever among the cattle of Iowa. Considerable attention is paid to the raising of horses, which find a ready home market at $100 to $150 each. For "all sorts of work," the Morgan breed is generally preferred.

More improvement is visible in the breeds of swine than in any other branch of stock raising. All counties in the State report the introduction of new breeds and new methods of crossing, rearing, and feeding them. The Magie, the Chester, and the Berkshire are in the highest repute. Formerly the shipment of hogs to market was confined to certain months; now, by the facilities of railroads, there is a constant stream eastward, embracing July and August, as well as December and January. This is one of the chief elements of the wealth of the State, and by it the enormous crops of corn find an easy market, and farmers at all seasons have about them a product readily convertible into cash. The hog cholera, sudden in its attack and spread, has been equally sudden in its departure; it occasioned great losses. No other diseases have prevailed, and ordinary skill and management have insured remunerative returns. The number of hogs shipped east in 1868 exceeded 430,000; a great increase over any previous year, though but one-fourth the number raised, the remainder being required for home consumption, and for shipment South by steamers, and West by the Union Pacific railroad.

Sheep husbandry has had its usual revulsions, and the fluctuations in the price of wool, the vexatious ravages of dogs, diseases, want of tame pastures, hard winters, &c., have proved discouraging. The Cotswolds, Southdowns, and other mutton sheep have been introduced in a few counties, and are considered profitable, notwithstanding the drawbacks named. Sheep farming was at its height in 1864, when upward of one hundred and fifty thousand sheep were taken into the State. The revulsions and fluctuations in this business, however, have not been without their value. Farmers have learned that tame pastures, protection from worthless dogs, from the blasts of winter, and the accidents of all seasons, and greater skill, science, and preparation are essential to success. The shipments of wool in 1868 exceeded 2,000,000 pounds—about the same as the year previous.

The area planted in corn exceeded by many thousands of acres the highest number ever before grown in the State; but the unusual drought and the frost of September 17 reduced the aggregate yield below expectation. Of wheat the acreage and the average yield were unparalleled. In the Southern Counties the winter wheat produced an excellent crop, and in the great spring wheat region of the North the yield was vast in quantity and of superior quality. In 1866 the crop amounted to 14,635,520 bushels, averaging fourteen bushels per acre. The shipments over eight railroads in 1865 were 3,331,769 bushels; this amount was increased annually till 1868, when it reached 8,836,243 bushels. Barley is a sure crop, though the great fluctuations in price have prevented its adoption as a standard grain. The product of 1866 was 1,197,729 bush-

els. Reports indicate a large increase in the breadth of land sown in 1868. There is not barley enough produced in the Union to supply the demand of the ale and beer brewers and drinkers, and large importations are made from Canada, and shipments have been made from the continent of Europe to Chicago. Of rye there has been a large increase. Only a few years ago it would not bear shipment, but was sold from 25 to 40 cents per bushel, and chiefly used in feeding hogs. It is, perhaps, one of the crops the least liable to failure. Experiments have been made in three distinct parts of the State with the White Polish oats introduced by the Department of Agriculture, and, though conducted under unfavorable circumstances, from drought and grasshoppers, they gave very encouraging results in weight and product.

Tame grasses are rapidly taking the place of the wild prairie grass, though a large portion of the western and north-western parts of the State still derives its hay and much of its pasturage from the native prairie growth. The southern counties are liberally supplied with meadows of timothy and clover, while the woodlands and open places have long been covered with white clover and a species of blue grass. The yield is very large of both wild and tame grasses, and immense quantities of seed are shipped eastward. The Burlington and Missouri River railroad, running a little south of the center of the region indicated, sent forward 1,918,931 pounds, against 100,617 pounds imported; while no mention of this product is made by any of the roads in the north part of the State.

The committee appointed to procure information on artificial groves, or the culture of forest trees, in Iowa, made an elaborate report, giving the results of inquiries in various counties, on the best kind of trees for the purpose, the planting and cultivation of the same, and the results. This important subject has not received that attention from the farmers of the State that it deserves. Iowa is nearly in the center of the great region of treeless plains extending from Indiana to the Rocky Mountains, about one thousand miles, and in the other direction more than a thousand miles, from Texas to Northern Minnesota. The surface of this immense system of prairies, an area of nearly a million square miles, or a space more than fifteen times the extent of Iowa, is broken only by the valleys of the rivers and their tributaries, and the belts of the adjacent forests. Of the 35,694,416 acres in Iowa, there is scarcely one-twentieth part timbered, even including the scattered outside trees and brushy borders of the limited and irregular forests. The proportion of forest to prairie is less in proceeding westward from the Mississippi and northward from Missouri. Forests, for timber and for protection from the cold winds of winter, are really the great want of the State. The correspondence from several counties contains interesting facts and suggestions on the most suitable trees for this purpose, the methods of planting, and estimates of the profits of timber-culture, apart from its other advantages. Reliance must be placed on such of the native species of trees as are free from the depredations of insects while growing to a size for use or to maturity. It is thought that the walnut, the maple, the hickory, the oak, and the cottonwood, with a few of the best evergreens, all western trees, will prove the most profitable varieties for culture.

The reports from county societies show that increased attention is being paid to the cultivation of fruit, particularly the apple and the grape. New orchards and vineyards are being planted all over the State. The Concord is the favorite grape, though many others are grown. The grape crop was enormous and the fruit superb; fifty thousand gallons of wine

were made in Des Moines County alone. Still the demand for fruit is a great way in advance of the supply. President Grinnell, of the Horticultural Society, states that while the swine raised in the State outnumber the people by one-half, there is scarcely half a pound of grapes, and but a single bearing apple tree, for each person. Suel Foster raised seven thousand pounds of grapes per acre. It is stated that they pay a reasonable profit at five cents per pound. Twenty years ago it was thought apples would become a drug in the market, instead of which they have been advancing in price all the time. It will be the same with grapes; there is no fear of glutting the market. No manure is required in the culture. President Matthews has tested one hundred varieties of the grape, none of which were troubled with mildew, except when manure was used, all the elements required by the vine and fruit existing in the natural soil. The blight has proved quite a discouragement to pear culture. The small fruits and berries have yielded good crops. Universal complaint is made of the imposition practiced by tree peddlers.

Efforts to form an agricultural museum at the capital have met with a satisfactory measure of success. It already comprises a collection of textile fabrics, seeds, and grains from the Paris Exposition, representing a large number of the nations of the world; about four hundred specimens of sorghum sugar and sirup, and the seeds and grains of Iowa. A moderate outlay would render practicable a complete representation of the products of the State; of all noxious and friendly insects; of all birds, animals, and reptiles visiting or inhabiting the State; of all soils, minerals, &c.; an exhibition at once attractive and valuable to the farmer, miner, and man of science. These things would assist the legislator in providing for the extermination of injurious birds, and the protection of those beneficial to the farmer and horticulturist, besides aiding him in other directions. More stringent laws are urged for the protection of game and useful birds. It is asserted that destructive insects are increasing every year, and that they destroy as great an amount of food as is saved.

Every county and district agricultural society, on complying with certain conditions, receives from the State an amount equal to that raised during the year from actual membership, up to $200. This measure has led to very satisfactory results, causing a great increase in the number of societies, and giving additional interest to agricultural fairs, which are rapidly becoming popular, as affording instruction, profit, and amusement. The receipts of the county societies in 1868 were $53,470; amount paid in premiums, $33,990; both items being about double in amount of those of the previous year. The total amount of State appropriation in aid of the State and county societies, in 1868, exclusive of publishing the Transactions of the previous year, was $11,957—a trifling sum in view of the vast interests which these organizations represent.

MISSOURI.

The fourth annual report of the State Board of Agriculture for 1868 is much larger than any preceding one, and contains valuable matter. It comprises the report of the State entomologist, of nearly two hundred pages, describing the noxious, the beneficial, and other insects of the State, including the fullest account yet published of the *Cicada*, or seventeen years' locust; the proceedings of the American Convention of Cattle Commissioners, at Springfield, Illinois, to investigate the subject of the cattle plague; the lectures of the professors of the Illinois Industrial University; and the proceedings of the Missouri State Horticultural Society.

A. M. Garland, in his lecture, says that in Spain there is an old proverb that "Gold springs up where the foot of the sheep has trod." This is true as applied to the wealth hidden and undeveloped in the soil. Beneath their "golden hoofs" the fields of Great Britain, after centuries of cultivation, rival in the production of wheat, and excel in their yield of grains, the fertile lands of the Western States. The facility with which the product of sheep is taken to market is a great argument in its favor. It requires one-half to two-thirds of the Indian corn sent to the eastern markets to pay its railroad freight. As sheep are usually fed in the West, it requires, say, one bushel of corn to make one and one-fourth pound of wool, hence the corn transformed into wool can be sent to the same markets at one-tenth to one-twentieth of its selling price. Of the 38,000,000 sheep now in the United States, much the larger portion is of the Merino family and its crosses. The American Merino has been brought to so high a state of perfection in Vermont that it furnishes a greater return in wool and mutton than any other breed. The mild climate of Missouri is very favorable for rearing sheep; they are wintered on prairie hay and corn, and foddered abundantly on the latter article, consuming about two bushels per head in four months. In the south-western part of the State they are not sheltered in winter, nor, indeed, are any other domestic animals, except work horses. Formerly eastern buyers visited Missouri and bought the clips of wool where it was bulked in the barn; now the wool-growers sack and ship it as soon as sheared.

Dr. Warder recommends greater attention to the culture of fruit, particularly the apple, as an article conducive to health, generally profitable in market in a pecuniary view, and consumed with avidity by stock animals. Swine will fatten on sweet apples, which also increase the flow of milk in cows. Apples can be raised on portions of the farm not adapted to other crops. Details are given on the culture of the proper sorts for a succession through the season. Grapes and the smaller fruits are also recommended. The pear blight has made great havoc in many orchards, some growers losing two-thirds of their trees. Notwithstanding the poor crops of apples for several years, from the destruction of forests and other causes, the planting of orchards is rapidly increasing.

Dr. L. D. Morse recommends the orchard grass as the most abiding of all grasses; it is sown to advantage with clover; grows quick when cropped by cows and sheep; is suited to all arable soils, and makes good pasturage after a rest of five days from being fed close. The well-known Kentucky blue grass is also recommended for the limestone districts. Mr. Flint says:

> Whoever has limestone land has blue grass; whoever has blue grass has the basis of all agricultural prosperity; and that man, if he has not the finest horses, cattle, and sheep, has no one to blame but himself.

George Husmann asserts that thousands of pounds of grapes are now produced where one pound was grown twenty years ago, and that this luscious fruit is now within the reach of all. He has tasted wines from all countries, at fabulous prices, but predicts that in twenty years we shall rival wine-producing nations and export wines to all countries. The cultivation of the grape is rapidly increasing, and it is already the most important fruit-growing interest in the State. While the markets are well supplied with this fruit, the great bulk of the crop is made into wine. In wine-making an intelligent mingling of varieties is recommended. The addition of even five or ten per cent. of the most of Norton's Virginia to that of the Concord evidently improves the

latter. These two kinds continue to be the leading varieties cultivated. (The delicious bouquet of Longworth's Catawba wine is said to be derived from a slight mingling of the juice of the Scuppernong.) The grape crop of 1868 was excellent throughout Missouri. The Concord maintains its high reputation in all parts of the State. It should be planted eight by twelve to sixteen feet apart. This distance makes a great difference in the labor, and in five years one has more fruit, and the vines will last longer. The Concord, with ample room, frequently produces one hundred pounds to the vine. Mr. Husmann recommends, for wines resembling Hock or Rhenish, the Delaware, Taylor, Rogers's Hybrids, Nos. 1 and 9, Cassady, and Maxatawney—the Delaware being pre-eminent, its juice having great body, the wine of crystal color and exquisite aroma; and in a few years it must compete with the most celebrated European wines; for wines resembling the white Hungarian, the Martha, Cunningham, and Rulander; for red wines, resembling Port and Burgundy, the Cynthiana and Ives's Seedling. The Concord is grown extensively, and frequently produces ten thousand pounds to the acre, although by the must scale it does not rank high in body. Mr. Husmann thinks it will produce *the* wine for the masses, a life and health-inspiring, gentle stimulant, destined to become the every-day drink of the sturdy laborer, and supplant the fiery whisky that has been too long a national beverage.

Elmer Baldwin considers the Improved Berkshire the best breed of swine for the West. The Chester White, also, though hardly yet established as a distinct breed, possesses a combination of good qualities. An April pig is worth one-third more than a July pig, and more than twice as much as one of September, and can be kept a year from the following January at less expense and trouble than a September pig. A sow with sucking pigs should have free access to grass and a generous supply of rich slop. Corn alone contains too much oil for growing pigs. Light grain, bran, and shorts, with grass and succulent vegetables, should constitute their food. After weaning, a pig should never be permitted to grow extremely fat nor very poor, which injures its thrift afterward. During the summer, before fattening, a clover or timothy pasture is indispensable to the successful and economical production of pork. The next best mode is soiling with clover, timothy, or other succulent grasses or vegetables. Confining in small pens and feeding with corn is the most expensive practice. Plenty of water, with occasionally a little salt, coal, and ashes, to correct the acidity of the stomach, completes the dietary as practiced at the West. Mr. B. has but little faith in specifics for hog cholera or any other disease of swine; has no faith in a sick hog. The best way is to turn him loose where there is plenty of water and leave him to nature and his own instincts. A mangy hog is considered worthless, and should be knocked on the head at once.

O. B. Galusha urges greater attention to forest trees on account of their influence on the atmosphere in purifying it, by absorbing noxious gases, equalizing its humidity, softening the asperities of its temperature, checking the force of violent gales, and thus insuring a carpet of snow to protect the roots of plants from the damaging effects of severe frosts. He thinks our home groves of forest trees are fast diminishing, and that the amount of pine timber in the extreme Northwest is greatly over-estimated. Several instances are given where a growth of timber was produced in sixteen or seventeen years, which raised the value of the land from $12 per acre so that $150 would hardly buy the timber now standing on each acre. Timber belts of double rows of

trees are beneficial in protecting grain crops from the effects of storms that so frequently sweep over treeless regions.

The receipts of the State Board of Agriculture for 1868 were $5,684 45; expenses, $3,892 85.

COLORADO.

From this vigorous young Territory we have reports of the third and fourth annual exhibitions of the Colorado Agricultural Society, held at Denver in the autumns of 1868 and of 1869. Large premiums had been offered on all kinds of live stock, farm implements, minerals, crops, fruits and flowers, and household manufactures. The railroads were liberal in transporting products at low rates, and the exhibitions were well attended. That for 1869 was held just ten years from the time when the first pioneer pitched his tent on the banks of Cherry Creek. Ten years ago the Territory was in a state of nature; it is now rapidly filling up with an enterprising population. Mining, though an important interest, does not receive exclusive attention. The wheat crop of 1869, larger than any preceding year, was estimated at 675,000 bushels; corn, 600,000 bushels; oats and barley, 550,000 bushels; vegetables and potatoes, 350,000 bushels, an increase of one-third over the crops of 1868. The average yield of grain per acre in the virgin soil of Colorado is far above that of the older States; common wheat is placed at twenty-eight to thirty bushels per acre; oats and barley thirty-five bushels; corn forty, and potatoes one hundred bushels. There are exceptional cases much higher. The Arnautka wheat, received from the Department of Agriculture, has produced sixty-five and a half bushels on a measured acre, and the result sworn to. The grain of this wheat, however, is considered too hard to make good flour. Common barley has yielded forty-five bushels to the acre. The Tappahannock wheat is reported as "doing splendidly, and is well adapted to the climate." The Odessa wheat sown on the 15th of April was reaped on the 13th of August, producing "an extraordinarily fine crop." These varieties were introduced by the Department of Agriculture. With a more careful culture of the soil, a more generous use of fertilizers, and greater care in irrigation, it is thought these averages can not only be maintained, but also increased. A desire for large farms is, however, too prevalent, and too many choose to cultivate largely rather than carefully.

The bullion product of 1869 reached $4,000,000, double that of 1867. Coal mines crop out all along the base of the mountains, and have been developed to an extent more than sufficient to supply the wants of the Territory. One mass of coal, eight feet long, three feet wide, and two and a half feet high, was exhibited at the fair, which weighed over two tons. Copper, iron, and lead mines and salt springs also exist, and when labor and capital are more abundant will add new sources of wealth and guarantee new pursuits to the young men of the country.

Stock-raising will ultimately become a leading business. The best thorough-bred cattle, horses, poultry, and sheep, including the Cashmere goat, have been introduced. One cow was on exhibition that gave twenty-two quarts of milk per day for five months. A steer can be raised to the age of five years at a cost not exceeding $10, or an annual expense of $2, for attention and occasional feeding with hay in extremely cold weather. An interesting object of the exhibition was a collection of upwards of one hundred stuffed birds, from a humming bird to the mountain eagle, most of which were caught, prepared, and arranged by Mrs. James A. Maxwell, to whom a premium of $50 was awarded.

Attention is paid to raising forest trees in all parts of the Territory. One man has a grove of three hundred walnut trees from nuts planted in 1865. The trees grew between three and four feet last year. He also has five or six acres of cottonwoods, planted in 1864, many of which are now over twenty feet high.

MINERAL FERTILIZERS OF THE MISSISSIPPI VALLEY.

The report of this Department for 1868 contained a brief notice of the mineral fertilizers of the Atlantic States, with such mention of the geological horizons in which they occur as seemed necessary to a clear understanding of their location, formation, and character. Mineral fertilizers were in that article divided for convenience as follows, excluding those purely or mainly mechanical in their action:

1. *Marls*—glauconite or greensand and calcareous, the latter including lacustrine or pond marls, when chiefly composed of carbonate of lime.
2. *Limestones*—including gypsum, native phosphate of lime, calcareous tufa, and the various limestones, marbles, and dolomites.

These two classes of fertilizing materials are noticed in the following pages. The geological structure of that vast and important region known as the Mississippi Valley presents a series of formations, representing a period of the immensity of which we can scarcely conceive, and exemplifying a large number of those great groups into which geologists have found it convenient to divide the constituents of the earth's crust. In the North, in Minnesota, Michigan, and Wisconsin, are outcrops of the oldest known rocks, formerly classed under a general head as Azoic, from the presumed absence of organic remains in the strata of which they are composed. These formations are now better known by the names given by the directors of the Canada survey, viz: to the lowest group, the Laurentian, and to the newer, which is of limited extent, the Huronian. The old notion that these rocks represented a time during which there was no organic life upon the globe, has been exploded by the discovery in 1860, in the lower Laurentian, of certain fossils of a low grade in the animal scale. Over these there has been much discussion as to whether they are or are not true fossils, a character now generally conceded to them. The formations once grouped as Azoic, therefore, are likely no longer to bear that name, and there is already a tendency to recognize them under the title of Eozoic, or earliest fossiliferous.

Next to the Eozoic, in the ascending scale, appears the lower Silurian, including sandstones, limestones, and dolomites. Four great developments of the rocks of this group are recognized in the Mississippi Valley. The first includes much of Minnesota, about half of Wisconsin, almost entirely surrounding the Eozoic, and extends into Iowa and Illinois. The second in point of size is the Silurian Basin of Southeastern Missouri and Northern Arkansas, which comprehends nearly half of the State first named. The third is generally known as the Cincinnati Basin, and lies one-half in Kentucky, about one-third in Ohio, and one-sixth in Indiana. The fourth, called by Professor Safford the Great Central Basin of Tennessee, is of exceedingly irregular outline, and is located as indicated by its name. South of this, Silurian formations, from east of the Appalachians, extend into Northern Alabama. The

lower Silurian is overlapped toward the South and East in Wisconsin and Minnesota by the upper Silurian, a group generally calcareous throughout the West.

The Cincinnati Basin is surrounded by the same formations, while in Missouri and Tennessee the upper Silurian is developed to but a small extent.

The oldest rocks which come into view in the southern peninsula of Michigan are of Devonian age, and extend into Ohio, Kentucky, and Indiana, surrounding and overlying the upper Silurian. Devonian strata appear again in Iowa, and are supposed to exist in Minnesota. Isolated outcrops of the same occur around the Silurian basin of Missouri, and at a few localities in Illinois. The Devonian of the West has a wide range of lithological character, limestones, shales, and sandstones occurring within the distance of a few miles. The Sub-Carboniferous formations separate the preceding from the coal fields. Of this group the Sub-Carboniferous or Mountain Limestone forms a large proportion, the remainder being grits, conglomerates and sandstones.

The coal field of Michigan occupies the center of the southern peninsula. The Appalachian coal field extends into Ohio, Kentucky, Tennessee, and Alabama. The Illinois coal field covers by far the greater portion of that State, a considerable part of Indiana, and stretches southeast into Kentucky. The coal fields of Iowa and Missouri occupy the southwest half of the former, and the northwest half of the latter State. The remaining western coal field, that of Arkansas, is but a prolongation of the great beds to which the coal measures of the States just north also belong. The coal measures of the West present a somewhat remarkable amount of interstratified limestone, especially in the upper members. These limestones, thin in Ohio, become gradually thicker and heavier toward the west, until in western Iowa they have attained such a development as to be recognized by some authority as a distinct group, under the name of Upper Carboniferous Limestone, or even of Permian. Professor Meek, however, ascribes these rocks to the upper coal measures proper, and the region in which they occur is so indicated on the accompanying map.

From the coal measures there is a gap in the geological chain until the Cretaceous is reached, unless we are willing to admit that the formation noticed in Minnesota in 1865 by Professor Hall, to be mentioned more at length hereafter, is Triassic, and so tends to complete the series. Cretaceous rocks enter Minnesota and Iowa from the extensive formations of that age upon the plains. In southwestern Arkansas also appear Cretaceous strata continuous with those of Texas. It is, however, in Mississippi and Alabama, of the States under consideration, that the Cretaceous attains its greatest development. The character of the Cretaceous deposits of the West is very different from that of the New Jersey beds, in that the greensand characteristic of the latter is wanting or present in very small quantity. The group in Iowa is composed of sandstone and calcareous marls, and in the South of marls, gypsum, limestone, and sandstone.

The Tertiary formations of the Mississippi Valley are entirely confined to its southern portion, extending from the junction of the Ohio with the Mississippi to the Gulf of Mexico. They include friable siliceous rocks, sands, limestones of various character, and peculiar lignitic beds.

Of Post-Tertiary formations, the Drift appears furthest north, and extends from the line of the great lakes southward into Missouri, Illinois, Indiana, and Ohio. The southern limit of deep drift is approximately indicated on the map by a strongly marked dotted line. The Drift of

the Western States differs much from that of the Eastern. It is composed in a great measure of marly clays or fine siliceous or calcareo-siliceous material, and as a rule presents few of the large boulders and water-worn pebbles so common on the Atlantic seaboard.

The formation recognized by Professor Swallow as the Bluff, and noticed below under the heads of Missouri and Mississippi, is considered by some geologists as the equivalent of the Löess of the Rhine, and by others as modified drift. Be this as it may, the drift agency has been one of much agricultural importance from the modifications of soil produced by importation of materials from abroad, and the often very thorough disintegration of the underlying rocks effected by it.

Most of the streams emptying into the Mississippi are bordered to a greater or less extent by alluvium of their own formation; and the great river itself, from Cairo southward, has laid down a belt of alluvial material of great extent. The agricultural value of these alluvial lands is everywhere recognized, and much of the wealth of the valley has been drawn from its rich bottoms.

ALABAMA.

In Alabama are represented the Silurian, Carboniferous, Cretaceous, and Tertiary systems; besides which the State is entered on the east by the southern terminus of the great metamorphic belt, which, beginning in Eastern Pennsylvania, extends southwest through Maryland, Virginia, North and South Carolina, and Georgia, east of the Appalachian chain. The Silurian, Carboniferous, and Metamorphic rocks occupy a little more than the northern half of the State; the southern portion is pretty equally divided between the Cretaceous and Tertiary, the former being the most northern. The Tertiary is bordered along the Gulf by formations of later date, of but little importance in an economic point of view.

The Cretaceous formation comprises a belt of country seventy to eighty miles wide, the southern boundary of which extends from the north line of Henry County on the Georgia border to the Mississippi line, at a point corresponding pretty nearly with the crossing of the Alabama and Mississippi River railroad, having a slight convexity toward the south. This formation also extends northward from the belt described, within a narrow range, along the west line of the State as far as Marion County. All south of this Cretaceous belt is Tertiary, and, with the exception of the counties of Chambers, Randolph, Clay, Coosa, and Tallapoosa, which are occupied by metamorphic strata, all north is Silurian or Carboniferous.

Calcareous rocks exist in all the formations of Alabama, save, perhaps, the Post-Tertiary of the Gulf coast. The older formations of the north afford limestones throughout their extent; in some localities the rock being true marble, while in almost all it is sufficiently pure for agricultural purposes. The greatest development of the calcareous rocks of the Silurian and Carboniferous ages occurs north of the Tennessee River.

Metamorphic limestones are mentioned as occurring in Talladega, Clay, and Tuscaloosa Counties; that of Talladega is noticed by Professor Tuomey as being somewhat cherty, which renders care necessary in its calcination, in order to prevent the formation of slag.

The Cretaceous limestones of Alabama are confined to the southern portion (two-thirds) of that formation, the more northern portion affording no minerals of value.

Prominent in this group is the "rotten limestone," celebrated among geologists for the great quantity of remarkable fossils which have been

found in it. This is generally somewhat argillaceous in character, bluish or grayish in color, and friable, but varies in consistence in different localities. By leaching and concretion it sometimes forms a singularly irregular, perforated rock, known in Alabama as the "bored," and in Mississippi, where it also occurs, as the "horse-bone," limestone. The lime of the rotten limestone varies from twenty-five to forty-five per cent., and phosphoric acid is often present in noticeable quantity.—(Tuomey.)

In the region where the rock just described occurs, there are also indications of the possible presence of greensand marls similar to those of New Jersey. Analyses of two specimens somewhat of this character will be found below.

In the Tertiary of Alabama, which is generally believed to be of the Eocene age, as is the case with that of Mississippi and Louisiana, is found, in addition to occasional beds of shell marls, a hard limestone, often of fine quality, which is especially developed in the counties of Clarke, Monroe, and Washington. These beds differ much in value, even in the same locality. Thus, in the bluff at Claiborne, on the Alabama River, the lower bed, according to Professor Tuomey, does not contain more than twenty per cent. of carbonate of lime, while the shelly stratum has fifty, and the overlying bed of white limestone sixty per cent. This last mentioned white limestone, termed orbitoides, or nummulitic, from a characteristic disk-like fossil, about the size of a twenty-five cent piece, is, throughout the region in which it is found, the most valuable of calcareous rocks. It is often nearly a pure carbonate of lime, containing over ninety-five per cent. of that material. The Tertiary limestones of Alabama, like those of the Cretaceous, often contain a valuable percentage of phosphoric acid.

Glauconitic or greensand marls also occur along the line of junction between the Cretaceous and Tertiary, in the latter formation. Of these, however, as of the similar deposits before mentioned, it must be said that they have not, as yet, assumed any special economic importance, and it remains for investigation and experiment to ascertain their extent and agricultural value. Tuomey mentions the existence of beds of this marl in Choctaw and Clarke counties, containing a large proportion of lime, and notices the marl at Baker's Bluff, Washington County, as having but five or six per cent. of lime, and thirty-three per cent. of greensand grains in the whole mass. The analyses given in this connection below are of the greensand grains. Of course the probable value of any given bed of this variety of marl, outside of that conferred by its calcareous ingredients, would depend on the amount of glauconite present.

The portion of the State overlying the older formations presents an alternation of low mountain ridges, with intervening flat valleys. These ridges often afford land well adapted to grazing, while the valleys are frequently of very rich soil. The Cretaceous belt is covered by prairie-like lands, which are often of great fertility, especially over the rotten limestone. Knobs of the underlying rock, often denuded of soil and bleached by exposure to snowy whiteness, make their appearance occasionally on the prairies, and afford easily accessible supplies of the fertilizer.

The soil of Marengo, Greene, Perry, Sumter, and Dallas counties is of remarkable depth and richness; this is ascribed by Tuomey to the uniformity of the underlying strata of rotten limestone, which prevents seepage and leaching.

The Tertiary portion of the State, though in many parts sandy and

unproductive, has numerous rich alluvial bottoms, while, in view of the liberal distribution of fertilizers through this region, it is probable that much land now almost valueless may, in the future, be improved and made productive.

Analyses of Alabama limestones.—(Mallet.)

	ROTTEN LIMESTONE.			MARBLE.
	Demopolis.	Jones's Bluff.	Cahaba.	Talladega County.
Soluble in hydrochloric acid:				
Carbonate of lime	75.07	80.48	64.37	35.67
Carbonate of magnesia	.72	.53	.79	2.51
Peroxide of iron	1.44	1.24	2.19	.39
Alumina	.79	.98	.75	
Phosphate of lime	.40	.37	.54	....
Silica	.14	.19	.06	....
Insoluble in hydrochloric acid	21.27	16.12	30.44	61.15
	99.83	99.91	99.14	99.72

Analyses of Alabama limestones.—(Tuomey.)

	ROTTEN LIMESTONE.		MARBLE.
	Pratt's Ferry.	Big Sandy.	McMurray's Quarry.
Carbonate of lime	93.00	90.00	88.00
Carbonate of magnesia	2.10	3.00	4.00
Silica and loss	5.00	7.00	8.00
	100.10	100.00	100.00

Analysis of picked greensand grains.—(Mallet.)

	Coal Bluff, 1.	Coal Bluff, 2.	Gainesville.
Silica	57.56	58.91	58.74
Alumina	6.56	5.48	4.71
Protoxide of iron	20.13	19.24	21.06
Lime	1.04	.71	.92
Magnesia	1.70	.87	1.48
Potash	4.88	4.58	3.26
Iron pyrites	....	1.46	....
Water	8.17	8.17	9.79
Total	100.04	99.42	99.96

MISSISSIPPI.

The surface geology of Mississippi is characterized by the presence, in almost every part of the State, of a drift formation, termed by Professor Hilgard "The Orange Sand," which, as its name indicates, is largely composed of yellow sands and sandstones, but which also includes siliceous rocks and sands of other colors, and some clays, but no calcareous material of value. This "Orange Sand" overlies the older formations of the State, which are limited to the Carboniferous, Cretaceous, and Tertiary periods. Of these, the first appears only as a narrow outcrop of the Sub-Carboniferous or Mountain Limestone, with its usual accompaniment of sandstone, along the Alabama line, in Tishemingo County, at the northeast corner of the State.

This rock affords both hydraulic and quick-limes of good quality. The

Cretaceous formation occupies a belt of country from twenty to thirty-five miles wide, along the eastern border of the State and the western edge of the Carboniferous, including Itawamba, Monroe, and Lowndes Counties, the greater portion of Tishemingo and Noxubee, the eastern half of Tippah, Pontotoc, Chickasaw, and Oktibbeha, and the northeast corner of Kemper. In this belt the limestones are confined to its western half. The eastern corresponds in character to the northern margin of the Alabama Cretaceous formation, and is divided by Hilgard into the Tombigbee Sand and Eutaw group. A strip through the center of the formation is occupied by rotten limestone similar in every respect to the rock of the same name in Alabama. This is more calcareous in the southern portion of its development than in the northern, where, in view of the proximity of the Carboniferous limestone, and the easy transportation by rail of lime from the better rock further south, it may be pronounced too impure for economical application.

Good lime is manufactured from the rotten limestone in north-west Monroe and northeast Chickasaw, and at more southern points. The western border of the Cretaceous belt presents a hard compact limestone, interstratified with "marlstones," from the latter of which, in many localities, lime sufficiently pure for agricultural purposes may be manufactured, while the harder layers furnish lime of admirable quality. These form the "Ripley Group" of Hilgard. Marls of the Cretaceous period are found in Mississippi, in Tippah, Pontotoc, and north Chickasaw, Tishemingo, and western Itawamba.

Those of the former three counties are sandy, micaceous, and contain a varying quantity of greensand grains. They also differ in consistence from perfect friability to a stony texture. The more earthy and loose varieties contain, according to Hilgard, ten to twenty per cent. of carbonate of lime, and one-half of one to one per cent. of potash.

The marls of Tishemingo and Itawamba are argillaceous rather than sandy, and contain more lime and less potash than the preceding, the proportion of the latter being often as low as one-fourth of one per cent., while the lime ranges from twenty to eighty per cent. of the carbonate, in the whole mass. Greenish sands are reported as occurring in Monroe, Lowndes, and Noxubee Counties, of which the specimens heretofore analyzed afford indications of little value, though they have not as yet been sufficiently examined to pronounce with confidence upon their character.

The Tertiary occupies the portion of the State not above mentioned, with the exception of the alluvial bottom between the Mississippi and Yazoo Rivers, and narrow strips of country along the first-named stream below Vicksburg and bordering the Gulf coast, all of which are Post-Tertiary. The formation was believed by Harper to be pretty equally divided between the Eocene and Miocene epochs, the former occupying the southern half, the latter the northern. The whole is now thought to be of the Eocene age, though the northern and southern groups vary much in character. A comparatively narrow belt of country, dividing the Tertiary of the State into two nearly equal parts, extending north-west by west across the State, from the center of the eastern border of Wayne County and the northern line of Clark County to Vicksburg and southern Yazoo, seems to include all the calcareous deposits of the Tertiary which are of noticeable value. The limits described include the Vicksburg, Jackson, and Claiborne groups of Hilgard, while he designates that to the north as "Lignitic," and that to the south as "Grand Gulf."

Throughout that portion of the State included by the Vicksburg,

Jackson, and Claiborne groups, marls and limestone are liberally distributed. A rich, calcareous marl is reported near Byram station, on the New Orleans, Jackson and Great Northern railroad; it is, however, somewhat injured by the presence of iron pyrites. Marl is also found in the southern part of Madison County and the northern part of Hinds, some of which contains sixty-two per cent. of carbonate of lime. A good article also occurs in Rankin County, and in north Clark is a bed of shelly, calcareous sand, containing a proportion of greensand, which may render it valuable, at least within the immediate neighborhood. Limestone outcrops at Vicksburg and at several points along the line of the Jackson and Vicksburg railroad. In Rankin County, on the line of railroad between Jackson and Brandon, is a bed of good quality. Other outcrops are reported in Wayne and in southern Yazoo Counties. In the Grand Gulf group are occasional patches of argillaceous marls, containing ten to twenty per cent. of carbonate of lime, a considerable amount of magnesia, and some potash, though no visible greensand grains.

The northern Tertiary of Mississippi contains extensive and wide-spread beds of lignite or fossilized wood, in a condition which has been described as intermediate between peat and coal. This is recommended as a fertilizer by Professor Wailes in his report on the geology of Mississippi, either as mined or after burning; but few will agree with him, however, in his estimate of the agricultural value of this material. In the lignitic district isolated masses of gypsum have been found in sufficient quantities to warrant the hope that extensive beds of this mineral may yet be unearthed.

In addition to the marls heretofore mentioned, Professor Wailes notices the occurrence of lacustrine marls in the Mississippi bottom. If these are found in quantity they are of some importance, lying as they do in a portion of the State removed from the older calcareous fertilizers.

Shell beds occur occasionally in the Post-Tertiary of the coast; but little, however, is known of their location or value. An extensive deposit of this kind is reported on Wolf River, twenty-one miles above Pass Christian.

The Cretaceous district includes the prairies of North-east Mississippi, which, overlying the rotten limestone, present the deep, rich soil, retentive of moisture, and very productive, characteristic of the similar region of Alabama. The southern part of the Tertiary, toward the Louisiana line and Gulf coast, is sandy and of less agricultural value, though numerous creek and river bottoms afford a considerable area of land capable of producing a bale of cotton per acre. The counties just back from the river, where the soil is partly formed by a calcareous löess, are perhaps the best of this region.

The richest portion of the State is the alluvial tract between the bluffs east of the Yazoo, and the Mississippi River. This, the well-known "Mississippi bottom," needs no further mention, as it can hardly be said to be modified in any great degree by the geological constitution of the State in which it lies, its mineral constituents being the detritus of all formations lying north of it in the course of the great river and its tributaries.

Analyses of Mississippi marls.—(Hilgard.)

	Clark County.	Hinds County.		Warren County.	Rankin County.	Carroll County.
Insoluble matter	45.881	37.400	12.308	20.967	13.074	55.705
Potash	1.717	.445	.611	.753	.265	1.604
Soda	.465	.208	.179	.283	.031	.045
Lime	14.785	28.821	43.932	37.543	46.222	.166
Magnesia	2.476	1.407	1.688	2.082	.614	1.630
Brown oxide manganese	.403	....	....	....	.067	....
Peroxide iron	13.020	5.133	2.696	4.722	2.722	34.347
Alumina	7.751					
Phosphoric acid	.327	.256	.224	.135	Trace.	Trace.
Sulphuric acid	.566	....	1.266	....	.058	....
....	....	....	Pyrites.	....	....	....
Carbonic acid	12.492	23.084	34.720	30.838	34.754	.129
Organic matter and water	....	3.246	2.396	2.657	2.050	7.012
Total	99.883	100.000	100.020	99.980	99.857	100.638

	Marion County.		Franklin County.	Lowndes County.	Tippah County.		Chickasaw County.
Insoluble matter	77.438	83.691	49.475	88.702	62.441	73.410	35.750
Potash	.709	.827	1.242	.204	.730	.702	.681
Soda	.101	.268	.152	.190	.272	....	.197
Lime	4.800	.793	13.190	1.351	7.952	6.315	20.558
Magnesia	1.248	1.053	1.825	.723	1.560	.886	1.366
Brown oxide manganese	.316	.223	.266	....	.160	.050	.305
Peroxide iron	2.989	4.394	5.538	5.598	11.849	7.055	4.190
Alumina	6.449	8.347	12.587		5.865	5.888	9.475
Phosphoric acid	.111	.148	.132	.328	.266	.046	....
Sulphuric acid	Trace.	.022	.033	.013	....	....	1.743
....	....	....	....	....	....	....	Pyrites.
Carbonic acid	3.372	....	9.555	.472	9.905	5.640	16.760
Organic matter and water	2.664	....	5.876	2.303			8.774
Total	100.197	99.766	99.871	99.884	101.000	99.992	99.799

Lake marl from Washington, Adams County.—(Emmons.)

Insoluble silica	17.44
Peroxide of iron	7.10
Carbonate of lime	70.44
Potash	3.64
Soda	.36
Magnesia	.64
Soluble silica	trace.
	99.62

Analysis of rotten limestone.—(Troost.)

Carbonate of lime	51.00
Insoluble earthy matter, green-sand, and mica	34.00
Carbonaceous matter	2.00
Alumina, water, and loss	13.00
	100.00

Analyses of Mississippi marls.—(Harper.)

	Wayne County.	Clark County.
Oxide of iron, alumina, and manganese	8.000	6.5562
Carbonate of lime	32.954	19.3636
Phosphate of lime	3.352	....
Sulphate of lime	3.684	....
Carbonate of magnesia	....	.1652
Chloride of magnesium	.900	....
Alkalies, (mostly potash)	7.840	.9784
Insoluble material	41.530	72.9402
Water and loss	1.740	....
	100.000	100.0036

Of these marls, that from Wayne County is estimated by the analyst to contain, per ton:

	Pounds.		Pounds.
Carbonate of lime	659	Chloride of magnesium	18
Phosphate of lime	67	Alkalies, (mostly potash)	156
Sulphate of lime	74		

This of course is a highly valuable marl.

Analyses of Mississippi limestones.—(Hilgard.)

	Chickasaw County.*	Pontotoc County.	Rankin County.	Tishemingo County.		
Insoluble matter	10.903	8.374	2.029	1.680	35.281	54.201
Potash	.248	.359	......	......	.348	.473
Soda	.320	.089	......	......	......	......
Lime	45.791	48.815	52.474	53.494	32.603	23.247
Magnesia	.877	.751	.667	.817	.630	.788
Brown oxide manganese	......	.173	......	......	......	......
Peroxide iron	1.421	2.412	2.125	.580	1.581	.903
Alumina	1.957				1.914	1.064
Phosphoric acid	......	......	.075	......	......	trace.
Sulphuric acid	2.840	.077	......	......	......	......
Carbonic acid	......	38.485	41.529	42.035	27.643	15.572
Organic matter and water	35.725	.832	1.100	1.340		3.752
Total	100.082	100.367	99.999	99.946	100.000	100.000

*Rotten limestone.

Analysis of Wayne County limestones.—(Harper.)

	Hard.	Soft.
Insoluble silica and alumina	6.300	15.050
Oxide of iron and soluble alumina	7.200	5.350
Carbonate of lime	86.500	79.600
Total	100.000	100.000

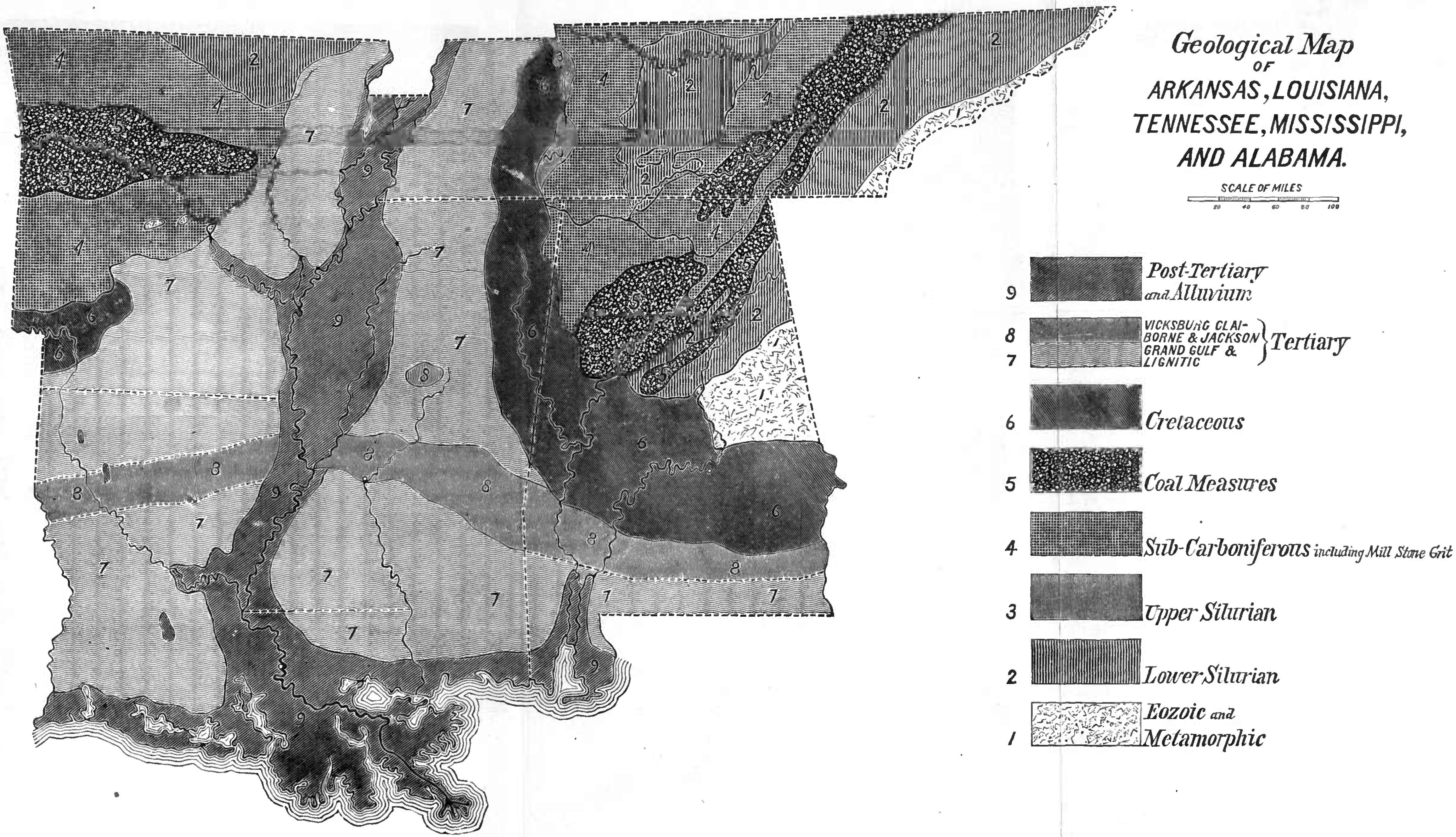
LOUISIANA.

According to Professor Forshey, the geological formations of Louisiana are Tertiary or alluvial and diluvial, the former occupying two-fifths of the State, lying north of an irregular line connecting Sabine River near the mouth of the Neches, and Harrisonburg in Catahoula Parish.

The formations in Louisiana ascribed by Professor Hilgard to the Vicksburg group appear to agree closely in character with those of Mississippi, although their eastern development seems to contain more limestones and marls than the western. North of this group appear the lignites characteristic of the northern section of Mississippi. Occasional outcrops of Cretaceous rocks are found along a line extending north-west from the parish of St. Landry, which are considered by the authority already cited to indicate the existence of a Cretaceous ridge, forming as it were "a back-bone to the State."

Limestones and marls appear to be liberally distributed throughout the State. Both are reported near Columbus on Bayou Taureau. In central Sabine Pass ledges of blue fossiliferous limestone were noticed. In Natchitoches the Wasatch Hills consist of alternating limestone and marl. On Sicily Island, near Harrisonburg, and on Anacoco Bayou, marl beds are found resembling the Pearl River marls of Mississippi, which have been successfully used as a fertilizer. In Winn and Rapides occur semi-indurated marls, with the peculiar orbitoides limestone already mentioned as existing in Alabama. In the parishes of Bossier, Bienville, and Winn, outcrops of limestone occur in the vicinity of salt licks

PLATE XLII.


Geological Map of Arkansas, Louisiana, Tennessee, Mississippi, and Alabama.
SCALE OF MILES
20 40 60 80 100
9 Post-Tertiary and Alluvium
8 Vicksburg Claiborne & Jackson
7 Grand Gulf & Lignitic
Tertiary
6 Cretaceous
5 Coal Measures
4 Sub-Carboniferous including Mill Stone Grit
3 Upper Silurian
2 Lower Silurian
1 Eozoic and Metamorphic

and springs, but these, together with a bed of calcareous rocks found in St. Landry Parish, are believed to belong to the chain of Cretaceous outliers already mentioned, especially as such borings as have been made have revealed the existence of gypsum underlying. In the south part of Winn and at Drake's salt works on Saline Bayou these limestones appear as ridges of some extent.

Of the Tertiary limestones of Alabama, Professor Hilgard remarks that the "limestones of the Vicksburg group, at many points, yield excellent lime, while the more impure varieties possess, in the large amount of glauconite they contain, special value for agricultural purposes. Good marls of various kinds also abound."

In Calcasieu Parish artesian wells, recently bored for oil, have revealed the existence, at a depth of four hundred and fifty feet, of an immense bed of pure crystalline sulphur, underlaid by six hundred feet of equally pure gypsum. The value of these discoveries is very great. The geologist says of them:*

As regards the sulphur bed, * * * * * * * its practical importance can hardly be overestimated. Its development requires, it is true, large capital and the best of engineering resources, in view of the depth and peculiar difficulties of drainage and ventilation; but who that knows the part that sulphuric acid plays in modern civilization, the monopoly enjoyed by Sicilian sulphur, the burdens naturally and artificially imposed upon its production in that island, and the inferiority of the acid prepared from pyrites, can fail to appreciate the intrinsic importance of a bed of pure sulphur one hundred and thirty-five feet thick, lying at a depth less than half of that at which some coal mines are profitably worked in Pennsylvania, and within ten miles of ocean navigation? The very gangue of the mineral, gypsum, is of sufficient value to agriculture and the arts to bear shipment for thousands of miles within the country, nor indeed is it likely that beds of such magnitude should be confined to a limited area and not be accessible at more advantageous locations. * * * * Boring operations have been suspended, and a company is now being formed with a special reference to mining the sulphur.

The alluvium of Louisiana is very extensive, stretching along the Mississippi River with a width of thirty to forty miles to just below Baton Rouge, where it becomes the delta, or, rather, what is generally so considered. The true delta is described by General Humphreys and Lieutenant Abbott, in their report on the "Physics and Hydraulics of the Mississippi River," as beginning about the mouth of Red River. Accepting the limits given by General Humphreys—which are, on the north, the Red River, Bayou Manchac, and Lake Pontchartrain; on the west, Bayou Teche and Bayou Petit Anse; on the south, the Gulf; and on the east, the Mississippi River—the area of the delta of the Mississippi is about twelve thousand square miles. Of this the more southern portion, about four thousand square miles in extent, is salt marsh. In addition to this, a strip of marsh, twenty to twenty-five miles wide, borders the whole southern coast from Petit Anse westward. The Red River, too, has its alluvial bottom of an average width of ten miles.

This vast alluvial region, with the exception of some very extensive shell-beds of undoubted human origin, contains no fertilizers of a mineral nature. It is, however, of the greatest agricultural importance. The statistics of the census of 1860 show that the parish of Tensas was at that time the most productive district of the cotton belt. Its average yield is given at a proportion of one and one-fifth bales of cotton per acre for the whole area of cultivated land, which of course implies a much heavier amount per acre for land in cotton only.

Next to the alluvium in fertility rank certain portions of the prairie lands, while other portions, covered by drift corresponding to the Orange Sand of Mississippi, are poor and barren; for the Orange Sand, when un-

* American Journal of Science and Arts for November, 1869.

mixed with silt, or the results of the disintegration of other formations, is far from productive.

A notice of the mineral fertilizers of Louisiana would perhaps be incomplete without some mention of the immense bed of salt discovered upon the island of Petit Anse, one of a chain of five, arising partly from the Gulf and partly from the coast marsh between Atchafalaya and Vermilion Bayous. This bed has been only partially explored as yet, but is estimated to be at least one hundred and forty-four acres in extent and thirty-eight feet thick. It is covered by, and, perhaps, imbedded in, formations of the Post-Tertiary age, though some authorities incline to believe that the salt bed itself is but another Cretaceous outlier. Of immense extent, wonderful purity, accessible by sea or by land, and within two hundred and seventy-five miles of the mouth of the Mississippi River, the importance of this salt deposit, which for several years supplied the greater portion of the southwest, is not easily exaggerated. At present it is mined with some little difficulty on account of drainage from the overlying Orange Sand, but it is hoped that the bed may be struck at a higher level, and this impediment obviated.

ARKANSAS.

The State of Arkansas, east of a line passing from the north-west corner of Louisiana to the Black River where it empties into the White, and along the former stream to the Missouri line, is occupied by the Tertiary and Post-Tertiary. The Tertiary presents the general characteristics of the Northern Lignitic group of Hilgard, and contains but little calcareous matter, which occurs in isolated beds.

This formation extends, in the counties of Clark, Hot Springs, and Montgomery, to the northwest of the limit indicated, and in this region are several of the few localities of Tertiary limestones.

The alluvium of Arkansas extends in the northeastern part of the State to a distance of fifty miles back from the Mississippi River, then, rapidly narrowing, almost disappears in Phillips County. Below this point it averages, perhaps, twenty miles in width, the Arkansas and White Rivers being bordered by alluvial deposits continuous with those of the Mississippi, which, in the case of the first, extend from Little Rock to the mouth of the river.

The greater part of Marion and of Fulton, the north-west half of Lawrence and of Randolph, and north-east half of Izard and of Independence Counties, are underlaid by magnesian limestones of the lower Silurian age, the southern extension of the extensive basin of these rocks in Missouri.

That portion of the State not included in the regions above outlined is of the Carboniferous or Sub-Carboniferous age, with the exception of some limited outcrops of Metamorphic rocks in the counties of Pulaski, Saline, and Hot Springs. The Coal Measures proper occupy the central part of the Carboniferous area, entering the State from the west, in the counties of Sebastian and Crawford, and extending thence nearly east as far as White County. The Sub-Carboniferous area includes limestones, sandstones, and grit.

In addition to the Tertiary, Sub-Carboniferous, and Silurian limestones already mentioned, the Cretaceous formation affords both limestone and gypsum, and in both Tertiary and Alluvium are occasional beds of marl. In the Silurian region marble and limestone are reported in Marion, Lawrence, Randolph, Fulton, Izard, Independence, and East Carroll.

Much of the Silurian limestone of Arkansas is too cherty for profitable application to the manufacture of lime. In the Sub-Carboniferous

region lime occurs in Van Buren, Searcy, Carroll, Madison, Benton, Crawford, and Washington counties; near Fayetteville, in the last-named county, are some beds of gypsiferous shale, which, pulverized, may afford a fertilizer of some value. In Pope County limestone is found only on Indian Creek.

In Conway County, on Turkey Creek, is a locality of limestone of good quality, which is of special value, being the only available source of lime in this part of the State, south of the Little Red, and north of the Arkansas River.

In Yell County, near the junction of Cypress Creek with the Arkansas River, an extensive outcrop of limestone is reported. Heavy beds of the same rock occur along Fourche la Fêve River, in Scott County; a thin layer is found on Gap Creek, Montgomery County; while considerable bodies of limestone of good quality reach the surface in Caddo Cove, in same county. At the Hot Springs, in the county of the same name, is a bluff of fine calcareous tufa, deposited from the waters. In the same county, near Rockport, and in the northern part of Clark County, limestone of the Tertiary epoch appears, as well as on Mill Creek and Saline River, in Saline County—in the latter locality as a compact blue rock. In eastern Pulaski are Tertiary limestones and marls, a bluff of the former upon Fourche Creek being mentioned by Owen as the best source of lime in the county. Marls probably exist in most of the districts in which limestones of that period are found. Beds of this fertilizer are reported in eastern Pulaski and north Bradley.

A qualitative analysis of shell marl from the last-named locality, of greenish color and granular structure, gave, according to Dr. Elderhorst, carbonate of lime, magnesia, iron, and manganese, potash, soda, and phosphoric acid in not inconsiderable quantities, together with an insoluble silicate. Argillaceous shell marl is found in Jefferson County, and some beds of very rich quality in St. Francis.

In Sevier County, the region around Ultima Thule is based upon marble and limestone of the Cretaceous age, and about one hundred feet of marl and marly limestone are exposed near Rocky Comfort in the same county. In Hempstead and Clark are many outcrops of Cretaceous limestone; in Okolona, Clark County, lime is largely manufactured for neighborhood use. In Pike County, extensive beds of excellent gypsum are found associated with limestone of equally good quality. These are located upon the Little Missouri River, forming bluff banks to that stream. As the Little Missouri is navigable during several months of the year, these gypsum beds bid fair to be of great value. Gypsum is said to exist in the northern part of Bradley County also.

In Greene County occurs a bed of gypseous clay, or rather of clay containing a large quantity of crystallized selenite. In view of the alluvial nature of this and other counties, this deposit may prove of value.

Niter caves, or caves containing nitrous earth, are found in North-west Arkansas, and niter has been manufactured to some extent. It is probable that thorough explorations of these caves, some of which are extensive, will reveal accumulations of bat guano, similar to that already in use in Tennessee. An analysis of a white niter earth from a cave in Marion County is given by Dr. Elderhorst, as follows:

Insoluble in hydrochloric acid	11.516	Sulphuric acid	1.375
Oxide of iron, and phosphates of alumina, lime, and magnesia	5.908	Nitric acid	.973
Lime	22.929	Carbonic acid	38.487
Magnesia	14.884	Organic matter and loss	2.760
Potash	1.106		
Chlorine	.062		100.000

or 1.791 pound of niter to 100 pounds of earth. An earth of a reddish color, from another cave in the same county, yielded to the same chemist, in 100 parts, 3.305 parts of anhydrous nitric acid, a proportion equivalent to about 124 pounds niter to the ton of earth.

Analyses of Silurian limestones.—(Elderhorst.)

	Lawrence County.	Marion County.
Insoluble silicates	6.701	3.191
Alumina	....	3.023
Carbonate of lime	53.998	50.041
Carbonate of magnesia	35.059	42.317
Carbonates of iron and zinc	4.231	1.950
Potash	.106	.435
	100.095	100.957

Analysis of tufa, Hot Springs County.—(Elderhorst.)

Carbonate of lime	96.550
Silica	.773
Oxides of iron, manganese, and alumina	1.315
	98.638

The region underlaid by the Cretaceous strata is very fertile, often presenting the deep black soil which has already been noticed as being found in those portions of Alabama and Mississippi of similar geological structure.

Much of the land located upon the grit of the Carboniferous age is cold, acid, and wet; alternating with this are warm, light, sandy soils, of tolerable fertility, but easily exhausted.

The counties of the northwest present valleys of considerable agricultural value, while many of the higher lands throughout the north of the State are available for grazing.

MISSOURI.

The basin of lower Silurian which appears in Northern Arkansas occupies nearly two-thirds of the width of the State of Missouri, from east to west, and extends north into the counties of Cooper, Moniteau, Cole, Callaway, Montgomery, Audrain, Ralls, Pike, Lincoln, and St. Charles. This formation reaches the Mississippi River in Cape Girardeau County, where, as well as in the county next north, (Perry,) there is a small development of upper Silurian. This again is bordered on the north by Devonian strata, extending from the river through the counties named, in a north-western direction into St. Genevieve County. Devonian rocks also outcrop in the counties of Pike, Ralls, Marion, Saline, Cooper, Boone, Moniteau, Cole, Callaway, Benton, Hickory, Polk, and Greene, bordering upon the Silurian strata, except in the six counties first named. The Silurian strata, with the exception just mentioned, viz., in Cape Girardeau and in Perry counties, are separated from the Mississippi River, from Ralls County to Cape Girardeau, by Sub-Carboniferous limestone and sandstone, and an irregular belt of the same separates the Silurian and the Devonian, on the north and west, from the Coal Measures which occupy the north-west two-fifths of the State. Sub-Carboniferous rocks are also found between the Coal Measures and the Mississippi

River, north of Ralls County, to the Iowa line. In addition to the alluvium of the south-east upon the Mississippi, the Missouri and other rivers are bordered to a considerable extent by alluvial bottoms and prairies. Professor Swallow includes with the alluvium, as Quaternary, a so-called Bluff Formation. This occupies the eminences, from which it takes its name, along the larger streams of the State, and overlies the Coal Measures through almost their whole extent. The Drift of Missouri, also included in the Quaternary by the authority just cited, is of comparatively little importance, being limited in extent, and where present often covered by the bluff. In addition to the formations above noticed, a few Metamorphic outcrops occur in Madison, St. Francois, and in Franklin County, affording rich stores of mineral wealth for which this portion of Missouri is noted.

In the Silurian region the limestones are chiefly magnesian; they are found in nearly every county in thick massive beds, and yield both limestone and marble of value. Many outcrops of these rocks occur outside of the main basin, in the belt above described, as comprising more particularly rocks of the Sub-Carboniferous epoch. Localities at which the Silurian limestones are available for economic uses, are reported in the counties of Perry, Cape Girardeau, Ralls, Pike, Franklin, St. Louis, Jefferson, St. Clair, Boone, Camden, Morgan, Miller, Marion, Cooper, Benton, St. Genevieve, Hickory, Polk, Dallas, Moniteau, Greene, Cole, Pettis, and St. François, and will probably be found throughout the entire basin. In the counties of Cooper, Boone, Marion, Ralls, Pike, Polk, Moniteau, Saline, Callaway, and Perry, are found limestones of the Devonian age, varying in character from a shaly, gray, coarse-grained rock, to a pure white öolite. Localities of good limestone are so numerous throughout the region of Sub-Carboniferous rocks that a detailed mention of them is unnecessary. In the Coal Measures occur calcareous strata of variable value.

In the Bluff Formation tufa is reported at many points, an extensive bed lying not far south of Parkville, in Platte County. In the counties of Marion, Dallas, and Camden, calcareous nodules are sometimes found in quantity sufficient to pay for working them into lime. In the shallow lakes of the river bottoms very large deposits of marl exist, and, as is usual, are still forming.

From the foregoing it will be seen that every section of the State of Missouri is abundantly supplied by calcareous fertilizers, and watered as it is by numerous navigable streams, the banks of which afford the most accessible outcrops of limestone, it is hardly conceivable that in any portion of the State these cannot be easily and cheaply applied. The alluvium and Bluff form the most fertile soils of Missouri, and as the Coal Measures are masked by the latter, these present the agricultural character of the overlying formation rather than that of their own proper components, save in a few denuded localities, which vary in fertility according to the members of the coal formation which reach the surface. The Drift, where it is uppermost, affords a pebbly siliceous soil of little value, but is in most places covered by the calcareo-siliceous bluffs.

The land overlying the limestones has the usual calcareous character, but in the region of some of the magnesian rocks the amount of chert, resulting from the decomposition of strata, is so great as to render otherwise good soil practically valueless.

Analyses of Missouri limestones.—(Swallow.)

	Pike County.	Benton County.	Benton County.	St. Francis County.	Cooper County.	Platte County.
Insoluble in nitric acid	....	6.67	....	....	....	....
Insoluble in hydrochloric acid	....	....	6.08	....	1.44	2.82
Silica	30.54	....	....	1.05	....	....
Alumina Oxide of iron	} 17.07	.98	.60	{ Trace {	} .38	4.03
Carbonate of lime	30.90	49.35	52.16	97.06	96.38	87.86
Carbonate of magnesia	20.02	41.98	40.39	1.70	....	4.82
Water	.70	.90	....	....	.76	....
	99.23	99.88	99.23	99.81	98.96	99.53

	La Fayette County.	Carboniferous—Missouri River.	Callaway County.	Franklin County.	St. Louis County.	Calcareous nodules—bluff.
Insoluble in nitric acid	....	....	}	....	....	....
Insoluble in hydrochloric acid	7.26	....	}	....	.50	35.08
Silica	....	16.31	} .51	6.77	....	....
Alumina Oxide of iron	{ 1.77 {	} 4.01	}	.97	{ Trace {	} 5.29
Carbonate of lime	90.12	69.77	98.93	49.64	99.40	58.33
Carbonate of magnesia	....	8.94	Trace.	42.05	....	.77
Water	....	....	....	....	....	....
	99.15	99.03	99.44	99.43	99.90	99.47

TENNESSEE.

Along the eastern line of Tennessee the rocks are Eozoic, with an occasional outcrop of Metamorphic; west of this rises a belt of the Silurian formation, about seventy miles in width, including rocks assigned by Professor Safford, in his late report on the geology of Tennessee, to the Potsdam, Trenton, Hudson, (or Nashville,) and Niagara epochs, the latter being but little developed in the belt mentioned. West of this, all of the State to the Tennessee River is of the Carboniferous age, with the exception of a somewhat remarkable outcrop of Trenton limestone, occupying the counties of Maury, Marshall, Bedford, Williamson, Rutherford, Davidson, Wilson, Sumner, Smith, DeKalb, and the western part of Cannon, with outliers along the lines of the streams in all the surrounding counties. This is the Central Basin of Tennessee, before alluded to.

Along the line of the Tennessee and some of its eastern tributaries rocks of the Niagara epoch again appear, in conjunction with others of the lower Helderberg series. West of the river, and extending entirely across the State, is a belt of the Cretaceous formation, having a width at the southern State line of about thirty-five miles, and near the Kentucky border of seven to eight miles. West of this again is a belt of territory about forty miles wide throughout the breadth of the State. Between this and the Mississippi River all is Post-Tertiary and alluvium.

In the lower Silurian of East Tennessee (Potsdam) are found thick

beds of dolomite and common limestone, forming the most massive calcareous strata in the State, and many of the ridges and valleys of that region. It is mentioned as occurring in the counties of Knox, Roane, Claiborne, Sullivan, Greene, Bradley, McMinn, Monroe, Blount, Polk, Jefferson, Sevier, and Hamilton, in the last forming the famous Missionary Ridge. Most of these ridges are somewhat cherty, or siliceous, but in many of them this is the case only on the south-eastern side, the northwest being of a much purer limestone. Limestone of the Trenton and Hudson epochs occur more or less in all the counties above mentioned, either as a thick, argillaceous blue limestone, or in thinner beds of marble, or ferruginous limestone, and, in addition to these localities, are also reported in Washington, in Carter, and in Hawkins County. In the last named this formation furnished the beautiful variegated Tennessee marble, so liberally used in the decoration of the Capitol at Washington.

In the great Central Basin the rocks of the Trenton and Hudson series are chiefly blue limestone in heavy beds, with occasional layers of a thinner flaggy rock. Throughout their whole extent they afford limestones of quality sufficiently good for the manufacture of lime, and in some localities marbles of different kinds.

Throughout the western valley of Tennessee the source of lime is the Niagara limestone, locally known as the "Sneedville lime," or, from a characteristic fossil, as the "Meniscus lime." This outcrops along the water-courses in the counties of Henry, Benton, Humphreys, Decatur, Perry, Wayne, and Hardin. The same formation occurs also in many localities on the border of the Central Basin, but owing to the abundant supply of calcareous material afforded by the older rocks it does not assume the same economic importance as in the more western outcrops, which are largely drawn upon for the supply of lime to the sands and clay lands of West Tennessee. The character of the rock is generally sufficiently good for lime manufacture; and, as in the other calcareous group of the State, marbles occasionally occur.

Lime is manufactured at many points along the western edge of this formation. With the last-named group, in many localities, occur light blue limestones of the lower Helderberg period, also available as a source of lime. The thicker beds of this group are on the western side of the Tennessee.

Throughout the region underlaid by the Carboniferous rocks are occasional beds of limestone, especially in the counties crossed by the Mountain Limestone, (Sub-Carboniferous,) which outcrops mainly along the western slope of the Cumberland table lands, viz: Franklin, Coffee, Warren, Grundy, Marion, Van Buren, White, Putnam, Overton, and Fentress.

In the coal region proper of the Cumberland table, although the ledges of limestone so often met in connection with coal are comparatively rare, yet outcrops of the Mountain Limestone and the calcareous rocks of the older formations are easily accessible.

In a very narrow limit in south-east Carroll and south-west Benton is the Greensand or Shell Bed of Safford, corresponding to the rotten limestone of Mississippi. As its name imports, this contains more or less glauconite and a large number of shells, though it is by no means so rich in the former as is the New Jersey Cretaceous. Nevertheless this appears to be through its extent a source of marls of considerable value, at least for local use. Experiments were made before the war with favorable results.

In the western portion of the Tennessee Cretaceous, occupying a tract ten or fifteen miles wide, extending across the State, appear formations,

(thought by Safford to correspond to the Ripley of Mississippi, though generally similar in lithological character to the Coffee Sand,) in which occur some localities of limestone which, in view of the lack of this material in West Tennessee, although impure, are somewhat important as a source of fertilizing material. These beds are located in Hardeman County, near the line of the Memphis and Charleston railroad.

The Tertiary of West Tennessee contains no material available for fertilizers, save that in the bluffs along the rivers, as in Mississippi, are occasional localities of calcareous nodules which may possibly afford a limited amount of lime, sufficiently pure for agricultural use.

In the limsetone regions of Tennessee are numerous caves, some of which are of great extent, and these generally contain nitrous earth, which was worked as a source of saltpeter during 1812–'14, and again to some extent during the late war. This earth may in some localities be found of value as a fertilizer. These caves have been for ages the homes of innumerable bats, and their accumulated droppings have formed a guano, the amount of which in some cases is enormous. This is now being manufactured into a commercial fertilizer at Hebeling's cave, Warren County, by admixture with the nitrous earth of the same locality. The manufacturer estimates the amount of bat manure in this single cave, so far as explored, at 30,000 tons.

The soils of the limestone districts are the best in Tennessee, varying much with the character of the underlying rock. The Central Basin, the counterpart of the famed "blue grass" region of Kentucky, is called by Professor Safford the garden of the State. The Cretaceous region has much soil of fine quality adapted to cotton and corn, with occasional ridges of very poor land. The Tertiary soils are often rich, and much of the best cotton land of the State is on this formation. It is, however, lacking in lime and is easily exhausted. The alluvial lands of the Mississippi bottom have the usual characteristics of great and lasting fertility.

Analyses of the limestones of Tennessee are not accessible; they will probably be found to correspond closely in character with those of Kentucky of like formation.

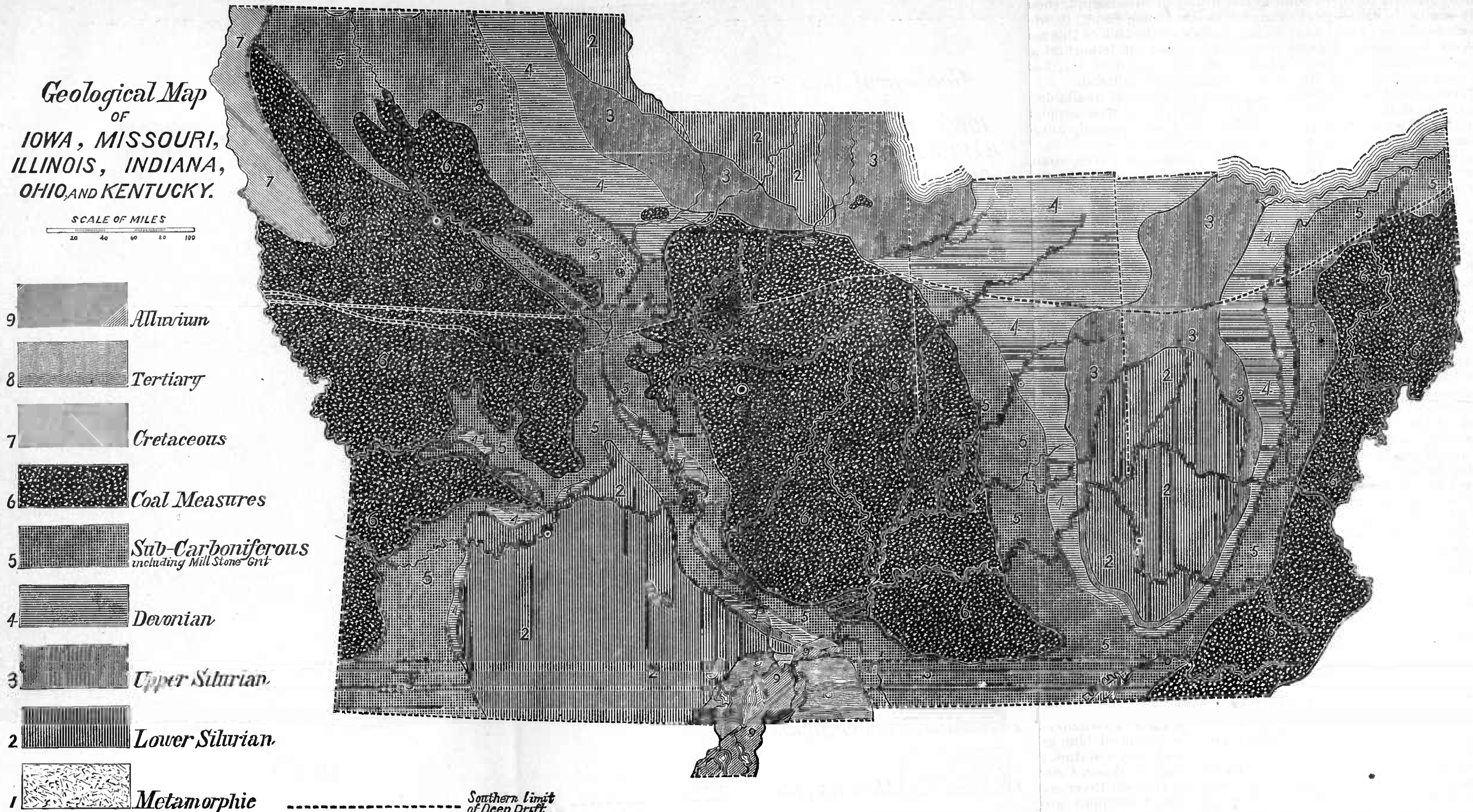
An analysis of the greensand marl of McNairy County, by Dr. Troost, is given below, of which Professor Safford remarks that phosphoric acid, though doubtless present, does not appear to have been separated:

No.	Silica.	Alumina.	Protoxide of iron.	Potash.	Carbonate of lime.	Water.	Loss.	Total.
1...	48.00	7.00	20.70	10.10	5.70	8.00	.50	100.00
2...	45.30	6.20	18.00	10.40	10.80	8.50	.80	100.00
3...	51.70	6.50	21.20	11.30	2.00	7.30	.00	100.00

KENTUCKY.

The Silurian basin of South-western Ohio, South-eastern Indiana, and Northern Kentucky, forms in the latter State the far-famed blue grass region, extending southward as far as Lincoln and Casey counties, and on the Ohio River from Trimble to the eastern side of Mason County. The formations of this basin, once classed with the Hudson River strata of the New York survey, are now designated the Cincinnati group. This basin of lower Silurian is surrounded by a narrow belt of upper Silurian limestone, and this again by a somewhat wider outcrop of Devonian shales. An extension of the Silurian basin of Tennessee enters Kentucky from the south through the counties of Monroe and Cumber-

PLATE XLIII.



Geological Map
OF
IOWA, MISSOURI,
ILLINOIS, INDIANA,
OHIO, AND KENTUCKY.
SCALE OF MILES
20 40 60 80 100
9 Alluvium
8 Tertiary
7 Cretaceous
6 Coal Measures
5 Sub-Carboniferous including Mill Stone Grit
4 Devonian
3 Upper Silurian
2 Lower Silurian
1 Metamorphic
Southern limit of Deep Drift.

land. The eastern border of the State is occupied by Coal Measures very similar to those of Ohio, with which they are continuous. The western extension of the coal is near a line passing from the Ohio River, a few miles east of the mouth of the Scioto, southwest to the boundary between Wayne and Clinton counties. The southern terminus of the Illinois coal field occupies the counties of Union, Henderson, Daveiss, Hancock, Ohio, Butler, Muhlenburg, McLean, Hopkins, and Webster, with a portion of the counties surrounding these.

The Kentucky Coal Measures are, as usual, bordered by Sub-Carboniferous rocks, chiefly limestone, the latter being more extensively developed around the western coal field than in the eastern portion of the State. With the exception of the groups already noticed, the remainder of the State, save that portion west of the Tennessee River, is occupied by sandstones and limestones the geological age of which has been much discussed, and which are laid down by Professor Dana (see Manual of Geology) as Devonian, while recent geological maps of the State group them as Sub-Carboniferous.

West of the Tennessee River the formations are Tertiary and Post-Tertiary. The Cretaceous group, though laid down in the western part of Kentucky on most geological charts of the United States, probably does not exist there, or at so great a depth as to have been as yet unnoticed. The Silurian basin, which underlies the counties of Trimble, Carroll, Gallatin, Boone, Kenton, Campbell, Bracken, Mason, Shelby, Henry, Franklin, Owen, Grant, Pendleton, Nicholas, Harrison, Bourbon, Fayette, Jessamine, Mercer, Woodford, Anderson, Boyle, Washington, and Spencer, with the greater part of Clark, Garrard, Lincoln, and Nelson, and a portion of Fleming, Bath, Montgomery, Madison, Casey, Marion, Jefferson, and Oldham, affords so many available localities of limestone that detailed mention of its occurrence is unnecessary. Of the tier of counties immediately surrounding those just mentioned, many are crossed by the belt of upper Silurian before noticed, which furnishes an article equally valuable for agricultural or mechanical use with that yielded by the older formations; in this group the limestones of Hardin County are magnesian in some of their developments. The counties of Rowan, Estill, Powell, Russell, Adair, Green, Barren, Taylor, and Larue also possess valuable limestone.

The Coal Measures of Kentucky contain many thick and valuable beds of limestone, few counties in the coal regions being without beds of this character. In the eastern coal field, localities of lime are reported in the counties of Whitley, Knox, Harlan, Letcher, Greenup, Carter, Wayne, Pulaski, Rockcastle, Clinton, Jackson, and north-western Clay. In some parts of Floyd County calcareous septaria exist in sufficient quantity to constitute a paying source of lime. In the western coal field thick beds of calcareous rock are found along the Ohio, the Green, and the Tradewater River, and in other localities in the counties of Hopkins, Daveiss, and Muhlenburg.

It will be seen from the foregoing that nearly every county in Kentucky either contains beds of calcareous fertilizers or is within easy reach of such. From this must be excepted, however, much of the region west of the Tennessee River occupied by Tertiary and Post-Tertiary in which no limestone or other available source of lime has been noticed other than occasional beds of an impure marl. Marls of various kinds exist in the counties enumerated in the subjoined table of analyses, and probably in many others. The soil of the blue-grass region has long been known for its great fertility; it is generally a black calcareous mold, with but little sand, and often two or three feet deep.

Perhaps no district in the West excels in agricultural value that around Lexington. The black shales and limestones of the Devonian belt both yield a rich and lasting soil. The soils overlying the Sub-Carboniferous rocks vary widely in character. Upon the limestones they are often of more than fair quality, though somewhat slow in the development of their value, and in the misnamed Barrens they are recognized as affording first-class grass lands.

Analyses of limestones, Kentucky.—(Prof. Peter.)

	Anderson County.	Bath County.	Bourbon County.	Bracken County.	Breckinridge County.	Bullitt County.	Carter County.	Christian County.	Clark County.
Carbonate of lime	96.65	53.24	75.98	91.04	60.05	63.45	50.78	52.20	85.56
Carbonate of magnesia	....	18.53	15.59	3.68	.10	29.64	3.22	37.95	3.56
Lime	....	....	....	....	....	....	....	....	....
Magnesia	....	....	....	....	....	....	....	....	....
Carbonic acid	....	....	....	....	....	....	....	....	....
Alumina and oxide of iron and manganese.	1.26	8.64	4.66	1.66	2.51	3.15	35.10	2.27	3.28
Phosphoric acid	.92	.11	.82	.18	.03	....	.95	....	.12
Sulphuric acid	.25	.63	.42	.26	.08	.27	.47	....	.47
Carbonate of iron	....	....	....	....	....	....	....	....	....
Carbonate of manganese	....	.38	....	....	....	....	....	....	....
Potash	.57	.44	.16	.20	.21	.20	.13	.28	.42
Soda	.39	.21	.04	.15	.06	.21	.07	....	.46
Silica	.88	17.54	2.64	2.88	34.58	2.18	1.88	6.38	5.92
Bituminous matter	....	....	....	....	....	....	....	....	....
Organic matter, water, and loss.	....	.26	....	....	2.36	....	7.39	.92	.18
Total	100.92	99.98	100.31	100.05	99.98	99.10	99.99	100.00	99.97

	Crittenden County.	Daveiss County.	Estill County.	Fayette County.	Fleming County.	Franklin County.	Grayson County.	Greenup County.	Hardin County.
Carbonate of lime	55.28	37.90	92.02	92.73	71.70	....	46.83	91.47	98.58
Carbonate of magnesia	29.24	16.66	.62	.63	9.93	....	26.84	2.75	.63
Lime	....	....	....	....	....	50.19	....	....	....
Magnesia	....	....	....	....	....	.66	....	....	....
Carbonic acid	....	....	....	....	....	40.15	....	....	....
Alumina and oxide of iron and manganese.	1.32	10.44	1.12	2.42	12.24	1.24	.38	.48	.46
Phosphoric acid	.11	.20	.31	.86	.63	.44	.12	....	.12
Sulphuric acid	trace.	3.15	.16	.34	.33	.68	.33	....	.27
Carbonate of iron	....	....	....	....	....	....	3.44	1.82	....
Carbonate of manganese	....	....	....	....	....	....	trace	.05	....
Potash	.34	.36	.19	.23	....	.48	.50	.13	.15
Soda	.05	.06	.08	.28	....	.44	.37	.10	.02
Silica	14.28	28.32	4.58	2.18	....	18.86	20.78	3.38	.38
Bituminous matter	....	....	....	....	....	....	....	....	....
Organic matter, water, and loss.	....	2.88	.89	....	....	....	....	....	....
Total	100.62	99.97	99.97	99.67	94.83	113.14	99.59	100.18	100.61

Analyses of limestones, Kentucky.—(Prof. Peter)—Continued.

	COUNTIES.								
	Henderson.	Jefferson.	Lawrence.	Lewis.	Livingston.	Lyon.	Madison.	Mason.	Mercer.
Carbonate of lime	88.38	50.76	50.95	55.24	91.68	86.38	49.32	87.98	90.72
Carbonate of magnesia	3.67	45.00	4.53	27.82	3.16	.54	30.72	1.72	4.61
Lime	....	....	....	....	....	....	....	....	....
Magnesia	....	....	....	....	....	....	....	....	....
Carbonic acid	....	....	....	....	....	....	....	....	....
Alumina and oxide of iron and manganese.	1.76	} 1.78	1.91	12.28	2.84	1.96	2.96	2.20	2.70
Phosphoric acid	.24	}	.36	.20	trace	trace	.27	.34	.14
Sulphuric acid	.16	.04	....	.15	.37	.88	.50	.37	(*)
Carbonate of iron	....	....	7.63	....	....	....	....	....	....
Carbonate of manganese	....	....	....	....	....	....	....	....	....
Potash	.28	.21	.57	.16	.22	(*)	.37	.28	.32
Soda	.06	.35	.31	.12	.02	(*)	.05	.04	.02
Silica	3.28	2.48	32.17	2.58	4.28	8.68	14.80	6.38	1.88
Bituminous matter	....	....	2.00	....	....	....	....	....	....
Organic matter, water, and loss.	2.13	....	....	1.42	....	1.54	1.60	.66	....
Total	99.96	100.62	100.43	99.97	102.57	99.98	100.59	99.97	100.39

	COUNTIES.								
	Meade.	Nelson.	Nelson.	Ohio.	Oldham.	Trigg.	Trimble.	Union.	Woodford.
Carbonate of lime	47.56	93.98	48.08	....	41.98	....	94.88	47.38	....
Carbonate of magnesia	26.51	2.79	29.66	....	21.40	....	1.11	19.60	....
Lime	....	....	....	47.06	....	43.91	....	....	54.12
Magnesia	....	....	....	2.39	....	7.00	....	....	.45
Carbonic acid	....	....	....	38.55	....	40.90	....	....	41.90
Alumina and oxide of iron and manganese.	} 2.16	.26	9.78	1.44	6.86	.36	.68	4.00	1.04
Phosphoric acid	}	.05	trace	.12	.31	.06	.05	.84	.63
Sulphuric acid	1.33	.53	trace	.80	.38	....	.20	.22	1.78
Carbonate of iron	....	....	....	....	....	....	....	13.55	....
Carbonate of manganese	....	....	....	....	....	....	....	.72	....
Potash	.12	.19	.53	.29	.37	.21	.19	.29	.48
Soda	.26	trace	.13	.24	.37	.09	.08	.16	.39
Silica	19.68	3.04	10.58	9.96	24.68	8.36	2.48	7.28	.78
Bituminous matter	....	....	....	....	....	....	....	6.16	....
Organic matter, water, and loss.	2.36	....	1.22	....	3.63	....	....	....	....
Total	99.98	100.64	99.98	100.85	99.98	100.89	99.67	100.20	101.57

* Not estimated.

Analyses of marls, Kentucky.—(Professor Peter.)

	COUNTIES.							
	Union.	Bullitt.	Fayette.	Fleming.	Grant.	Jefferson.	Mason.	Owen.
Organic and volatile matter, water and loss.	7.060	1.904	5.676	13.900	1.532	2.196	.791	8.998
Alumina and oxides of iron and manganese.	6.700	5.480	24.656	22.245	16.250	7.260	8.020	19.940
Carbonate of lime	50.850	41.740	2.480	16.880	4.980	26.880	7.380	34.580
Magnesia	.698	1.088	3.276	6.365	3.285	1.687	3.105	5.287
Phosphoric acid	.280	.157	.182	.079	.310	.694	1.040	.934
Sulphuric acid	1.366	.066	....	.338	1.197	.406	.592	.372
Chlorine	.062	....	....	....	....	....	....	....
Potash	.310	.573	6.655	1.147	.988	.965	.722	.649
Soda	.166	.152	.195	....	.178	.012	.170	....
Sand and insoluble silicates	32.670	48.840	56.880	39.780	71.280	59.900	78.180	29.240
Total	100.162	100.000	100.000	100.754	100.000	100.000	100.000	100.000

OHIO.

The Coal Measures of Pennsylvania and Western Virginia extend into Ohio, occupying nearly the eastern one-third of the State. They are bordered on the north and west by Sub-Carboniferous conglomerate and grit, and this, again, is abutted by a belt of sandstones and shales usually ascribed to the Devonian age. The shales are considered the equivalent of the Hamilton shales of the New York survey. In reference to the sandstones, locally known as "Waverley," there is much doubt whether they are to be assigned to the upper Devonian or lower Carboniferous. Some maps locate them in the latter, and a group has lately been proposed by the directors of the geological survey of Illinois, to include these, and other similar formations in the West, under the name of Kinderhook, located at the base of the carboniferous system.

A line extending from the Pennsylvania border through the center of Trumbull County, around the northern edge of Geauga, through Summit and Medina counties to Medina, and from the last-named point, irregularly drawn, with curves toward the east, in the counties of Knox and Vinton, to a point on the Ohio River a few miles east of Portsmouth, would pretty nearly coincide with the limits of the Carboniferous rocks, excluding the Waverley. The last, with the shales above mentioned, are limited to a strip of country to the north and west of the Carboniferous, averaging perhaps twenty-five miles in width, narrowing toward the south. Their western border is approximately defined by a line extending from the center of Erie County, on the lake, to the center of Adams County, on the Ohio River. The counties of Hamilton, Clermont, Brown, Warren, Clinton, and Butler, about half of Preble, Montgomery, Greene, and Highland, and a small portion of Fayette and Adams, are underlaid by the Cincinnati Basin of lower Silurian limestone. North of this, and between the eastern limit of the Cincinnati group and the Devonian shales, the rocks are the so-called Cliff limestone, a formation concerning the age of which there has been much discussion among geologists, it having been early assigned to the Sub-Carboniferous epoch, and of late years to the lower Devonian or the upper Silurian. Professor Hall considers it to be of the latter system, and it is, therefore, together with the extension of the same formation into Indiana and Kentucky, marked as upper Silurian in the accompanying maps. This formation covers all Ohio not already described, except a limited region in the north-western corner of the State, and a narrow district along the Indiana line from about its center northward, which are Devonian.

With the exception of the Hamilton shales and the Waverley sandstones all the geological formations of Ohio afford lime of good quality and in inexhaustible quantity; and even in the counties located on the excepted district the fertilizer is so readily to be obtained on either hand that no land need suffer from want of liming.

The lower Silurian, or as it is locally termed the blue limestone, is characterized by its occurrence in broken but not displaced layers, alternating with clayey marls. It is a compact, hard, semi-crystalline rock, rich in fossils, and affords a high percentage of carbonate of lime, as shown by the following analysis of a specimen from the hills near Cincinnati, by Professor Locke, and more fully by the analysis of the same rock in Kentucky, before given:

Carbonate of lime	90.93	Silex from solution	.77
Peroxide of iron	3.15	Water expelled at ignition	1.13
Insoluble in hydrochloric acid	1.80	Loss	1.11
Carbonate of magnesia	1.11		
			100.00

Very different from the fragmentary layers of the lower are the massive strata of the upper Silurian, often eighty feet thick without a seam, and standing out along the banks of streams in high perpendicular, or even overhanging walls, whence its local name of "Cliff." This rock varies widely in character in different localities, and even in the different layers of the same outcrop. In general it is less hard and compact than the blue limestone, but sometimes approaches the latter in these qualities, as at Dayton. It is often spongy and porous, as in Preble County, and while frequently nearly destitute of fossils, is often also a mere agglomeration of them. This limestone usually affords a rock excellent for manufacturing purposes. The following analysis by Professor Locke may, perhaps, with the exception of the pyrites, be taken as an index of its general composition, at least in its more compact portions:

Carbonate of lime	92.40	Iron pyrites	.10
Protoxide of iron	.53	Water expelled at ignition	1.08
Insoluble in hydrochloric acid	1.70	Loss	2.19
Carbonate of magnesia	1.10		
Silex from solution	.90		100.00

The Devonian strata of the north-western part of the State are calcareous, and where accessible will probably yield valuable limestone; both they and the northern extension of the upper Silurian are, however, so deeply covered by drift as to be in many cases entirely out of reach. The Drift itself, in some localities, contains calcareous pebbles and boulders in sufficient quantity for economic application. In Mahoning County nodules of gypsum are reported as occurring in the Drift. Throughout the coal field occasional layers of limestone are found interstratified with the coal and its usual concomitants.

The gypsum beds of the peninsula of Ottawa County have been extensively worked for the last sixteen years, and in that time have yielded an immense quantity of this invaluable fertilizer. The amount annually quarried by one firm, owning some four hundred acres of land, all of which is supposed to be underlaid by gypsum, was estimated in 1866 at ten to twelve thousand tons, and yet but five acres had been exhausted. The average thickness of the gypsum beds in this region is considered to be about seven feet. Gypsum is known to exist in Erie County also, but so far as known it lies at too great a depth to be economically extracted, while the neighboring beds are productive. Professor Newberry, in a recent letter to this Department, estimates that about one-third of the whole amount of gypsum mined in Ohio is used for agricultural purposes.

The following analysis of Ohio gypsum, by Professor L. R. Fisk, of the Agricultural College of Michigan, is the only one at hand:

Water	20.8631	Lime	31.5628
Silicic acid	.0235	Potassa	.2676
Alumina and oxide of iron	.7626	Soda	.0944
Sulphuric acid	45.8303	Chlorine	.0050
Total			99.4093

The marly layers of the lower Silurian limestones, before alluded to contain twelve to thirty-five per cent. of the carbonate of lime, and, somewhat similar beds are found in connection with the other limestones of the State.

Lacustrine marl is mentioned as having been noticed in Crawford and Erie, existing in the latter in extensive beds. Large deposits of this

fertilizer underlie the peaty swamps of the northern counties, the value of which as a fertilizer is stated by Professor Mather to be fully equal to that of like deposits in New York, analyses of which were given in the report of this Department for 1868.

The following list of reported localities of available limestone may be found convenient for reference:

Lower Silurian limestone.—All the counties mentioned above as forming the Cincinnati basin.

Upper Silurian limestone.—The counties of Champaign, Clarke, Crawford, Delaware, Erie, Franklin, Hancock, Highland, Logan, Marion, Miami, Morrow, Ottawa, Pike, Sandusky, and Wood.

Carboniferous limestone.—The counties of Athens, Belmont, Coshocton, Hocking, Jackson, Jefferson, Licking, Muskingum, Perry, Portage, and Washington, marl occurring with the limestone in Belmont and Washington.

Analyses of Ohio limestones, other than those heretofore given, are not accessible.

The Drift formation of Ohio, though composed largely of foreign material, is, as usual, mingled to some extent with the products of the decomposition of the underlying rocks, and its agricultural character so modified. The soil overlying the Silurian limestones is markedly calcareous, least so, perhaps, in the swamp region of Northern Ohio. The counties upon the sandstone and shale belt present strong resemblances in their character and productiveness to the dairy farm regions of New York, which are upon similar or identical geological formations. The soils of the Carboniferous region vary in character as shale, sandstone, or limestone is the predominant rock.

INDIANA.

Indiana's share of the Cincinnati Basin of lower Silurian limestone is confined to the counties of Fayette, Union, Franklin, Dearborn, Switzerland, the eastern parts of Ripley and Jefferson, and the southern half of Wayne. This is bordered on the north and west by a belt of upper Silurian (Cliff) limestone, which is much wider in its northern extension. Upper Silurian strata again appear in the north-western counties near and on Lake Michigan. A line drawn from New Albany, on the Ohio River, north-west through the western part of Jackson County, thence north-east to the eastern line of Johnson and Marion, thence north-west to the Illinois border, between the counties of Benton and Newton, will include the Carboniferous rocks of the State. These include the Sub-Carboniferous sandstones corresponding to the Waverley of Ohio; Sub-Carboniferous limestones and Coal Measures proper. The latter lie in the counties of Warren, Fountain, Vermilion, Park, Vigo, Clay, Sullivan, Knox, Daviess, Pike, Gibson, Posey, Vanderburg, Warrick, and Spencer, and the western part of Putnam, Owen, Greene, Martin, Dubois, and Perry. If the belt of Sub-Carboniferous rocks thus outlined be divided so that the western section shall be narrow at the north and wide on the Ohio River, and the eastern the contrary, these divisions will nearly represent the locations of the Sub-Carboniferous sandstones which lie furthest, and the Sub-Carboniferous limestone which intervenes between it and the Coal Measures.

The limestone of the Cincinnati group closely resembles that of the same formation in Ohio, and is generally a coarse, blue, shelly rock, with occasional beds of shale. The upper Silurian strata also correspond nearly with the Ohio rocks of like age; as a rule, gray or creamy in color, compact, fine-grained, and yielding a large percentage of carbon-

ate of lime, though in some localities, as near Logansport and Peru, strongly magnesian.

The Devonian rocks include limestones, probably of the Corniferous group of the New York survey, and Hamilton shales; the latter, as in Ohio, forming a belt parallel to the Sub Carboniferous sandstone. The Sub-Carboniferous limestone is of the finest quality, both for building and the manufacture of lime; is easily quarried, and presents in Indiana as in Kentucky extensive caverns, and the numerous depressions known as sink-holes.

In the Coal Measures limestones are interstratified with the coal, shales, and sandstones. Of these limestones Professor Owen remarks:

> They are generally of a dark color, either gray or brown. * * * They are by no means extensive; indeed, it is doubtful whether there is any universal stratum of limestone occurring in these Coal Measures. For this reason the inhabitants frequently have difficulty in procuring limestone for economic purposes.

The same authority mentions strata of limestone in Posey County, of the Coal Measures series, which are of unusually good quality, and also in the counties of Vigo, Daviess, and Gibson. In Vanderburg County limestone occurs just north of Gentersville. The Sub-Carboniferous limestone has been worked near Bedford, Lawrence County, furnishing enormous slabs of stone of fine quality; it has also been quarried in the counties of Monroe, Greencastle, Putnam, and Montgomery, and at many other points unreported. According to R. T. Brown this limestone contains, on an average, ninety-two to ninety-six per cent. of carbonate of lime.

From the limestone of the Devonian system a justly celebrated article is, or was, manufactured extensively at Utica, Clarke County, known as Louisville lime; and between Logansport and Delphi, along the Wabash, this rock crops out largely. The upper Silurian limestone has been quarried on an extensive scale near Vernon, Jennings County, but is somewhat argillaceous at this point. At Greensburg, Decatur County, a bed of fine quality, but in thin layers, has been laid open; much thicker beds are found near Milford in the same county.

Calcareous tufa occurs at many places in Indiana, and as these are often in regions deeply covered by drift, its economic importance is considerable. Localities of this fertilizer are reported in Carroll County, on the Wabash, and in Montgomery, as well as other counties farther north.

Marls occur, interstratified with the lower Silurian limestone, as in Ohio, and in some of the more southern counties of the coal measures. No localities of lacustrine marls are reported, though without doubt many exist. An analysis of a marl from Posey County will be found below.

The Drift formation of Indiana covers all of the northern, and to a certain extent much of the central part of the State. From this fact the quality of soil in any given locality in these regions cannot safely be predicated on the character of the rocks underlying *in situ*. Fortunately, however, the Drift itself, while in the center of the State masking, and in the northern counties entirely concealing, the older formations, affords of itself a soil of great fertility. South of the Drift the soil is modified as usual by the rock on which it rests, and from which it has been formed; and as the greater part of Indiana is underlaid by calcareous rocks, the soil has a high average of fertility.

Analysis of ferruginous limestone, Vermilion County.—(Prof. Owen.)

Carbonate of lime	84.0	Loss	2.8
Insoluble matter	9.6		
Protoxide of iron	3.6		100.0

Analysis of marl, Posey County.—(Prof. Owen.)

Moisture	2.0
Carbonate of lime	36.2
Insoluble	60.0
Oxide of iron	0.8
Loss	1.0
	100.0

MICHIGAN.

The geological formations of Michigan range in time from the Eozoic to the upper Carboniferous, in addition to which the universally present Drift and other Post Tertiary formations occur, and some outcrops of igneous rocks. The older strata, including the Eozoic, lower Silurian, and upper Silurian, are confined to the upper peninsula, with the exception of one group, to be particularly noticed hereafter.

The general geology of the upper peninsula will, perhaps, be better described with that of Wisconsin. It may suffice, in view of the fact that the agricultural capabilities of this portion of Michigan are as yet almost entirely undeveloped, to state that the Laurentian, the Calciferous Sand Rock, and the Trenton of the lower Silurian, and the Niagara, Cincinnati, (Hudson River,) and Salina group, of the upper Silurian, all afford lime of good quality, while veins of pure calcareous spar are found in some of the igneous outcrops.

The formations of the lower peninsula have been happily compared by Professor Winchell, director of the geological survey of Michigan—who has kindly furnished much original information upon the economic geology of that State, of which free use has been made—to a nest of rocky dishes, the inner filled with coal. It is to this peculiar and unbroken dish-like disposition of strata, some of which are impervious to water, and retain the saline matter leached from others, that Michigan owes her unfailing sources of brine. The rim of the outer crop makes its appearance in the most northern counties and also in the south-east, in the counties of Monroe and Wayne, as the lower Helderberg of Silurian age, and the upper Helderberg of the Devonian system. These geologically distinct groups are, in Michigan, physically one mass, and have only lately been resolved by the labors of the authority above quoted. The beds of the lower Helderberg are bituminous and impure; those of the higher group afford excellent lime, for which they are extensively quarried, and, disintegrating easily, yield much calcareous matter to the soil. Next to the last described, toward the center of the State, comes a belt of Devonian rocks, corresponding in age, though not in lithological character, to the Hamilton group of New York. These outcrop extensively in the regions of Little Traverse and Thunder Bays, and may be easily quarried in any amount. They vary from a bituminous character to one aluminous, crystalline, and dolomitic. Inside of these again occurs a belt of black, bituminous slates, the exact geological age of which is somewhat uncertain, and which are described by Professor Winchell as the Huron group of the Devonian.

Within and next to the Huron group, sandstones outcrop widely, the Napoleon and Marshall groups of the Michigan survey. These are assigned by Professor Winchell to the lower Carboniferous epoch, and are considered the equivalent of the disputed Waverley sandstone of Ohio. Still further toward the center of the State the Michigan salt group appears. This, the most important source of fertilizing material in the State, is composed of alternating layers of saliferous shales, gypsum, and magnesian limestone. This also is of the lower Carboniferous age. Within the range of the salt group, a belt of Carboniferous limestone next outcrops, especially in the region of Saginaw Bay and the counties of Kent, Newaygo, Eaton, and Jackson; and between this and the

Coal Measures another of sandstone, known as the "Parma," which in the accompanying map is included in the coal measures proper.

The Coal Measures of Michigan occupy nearly the whole of seventeen counties in the center of the State, these being Clare, Gladwin, Bay, Mecosta, Isabella, Midland, Montcalm, Gratiot, Saginaw, Ionia, Clinton, Shiawassee, Genesee, Eaton, Ingham, Livingston, and Jackson. The coal is covered by sandstone, the "Woodville," and interstratified with shales and clays.

The Drift of Michigan, more especially in the lower peninsula, supplies material for the manufacture of lime, in the shape of pebbles and boulders of calcareous rock. The gypsiferous and saliferous formations of Michigan merit, from their economic importance, more minute description. They are two in number, the Salina, which underlies the entire lower peninsula and outcrops to a limited extent in Monroe county, and also on the islands north of Mackinac and the main-land west of them. At Little Point au Chêne, a few miles west of Mackinac, this formation yields gypsum, at points immediately upon the lake shore. It is the Michigan Salt group, however, which affords by far the greater part of the gypsum quarried. The outcrops of this group have been traced through the counties of Barry, Kent, Muskegon, Oceana, Mason, and Iosco. It is principally worked in Kent and Iosco. The quarries in the former have been extensively opened and lie at a distance of two to four miles from Grand Rapids. The mineral occurs in beds from four to thirteen feet in thickness, generally near the surface, but has been mined deeply in some of the hill-sides. The product in general is of the quality usual elsewhere, but of the thickest bed much is of unusual purity.

The workings in Iosco County are on the navigable Saginaw Bay, at Alabaster Point. The mineral lies massively in two beds, aggregating eighteen to twenty-three feet in thickness, and is of great purity. From these quarries, in 1868, the shipments amounted to 27,000 tons and 15,000 barrels; those of 1869 were much larger. The supply seems inexhaustible, and its position gives unusual facilities for its removal.

Gypsum is reported in Ogemaw County, but has not been worked as yet. The salt beds of Michigan are three in number, the Salina, the Michigan Salt group, and the Coal Measures. In each of these salt wells have been successfully bored. The Coal Measures, however, supply only a few shallow wells near Bay City. The Salina group supplies the wells of St. Clair, of Macomb, and of Huron County. The Michigan Salt group is that, however, which affords by far the largest number of productive wells. These are generally located in the Saginaw Valley, and average, perhaps, eight hundred feet in depth. The supply from these strata is practically inexhaustible, and the brine is often nearly or quite at saturation point. At many places where brine sufficiently strong for the successful manufacture of salt could not be obtained, it might be found sufficiently charged with saline matter to serve a good purpose in agriculture. Such localities exist throughout those belts of the peninsula in which occur outcrops of the saliferous strata, or may be better sought, Professor Winchell thinks, from ten to twenty miles nearer the center of the peninsula. Analyses of Michigan brines will be found below. The marls of Michigan are exclusively lacustrine. Professor Winchell says of them:

> The supply of marly fertilizers in Michigan is very great. It would be literally impracticable to enumerate one-twentieth of the deposits. They exist in every county and perhaps in every township of the State. They vary in dimensions from a rod or two to a mile or two, or even more, in diameter.

The different deposits vary in character; some are sufficiently pure to be burned for lime. Iron and manganese often exist as an impurity. An examination of an average sample of pond marl from Howell, Livingston County, yielded to Professor Winchell the following results: Unbroken shells, not microscopic, .525 per cent.; vegetable fibers, 1.099 per cent.; dried at 212° and pulverized, it absorbed in fourteen hours 1.642 per cent. of moisture; saturated with water, it held 111 per cent.

Specific gravity of absolutely dry marl, 1.655.

On analysis, one hundred parts by weight contained—

I. Vegetable matter:		
Humic acid	1.2940	
Humus	.7260	
Other volatile matter	27.0100	
		29.0300
II. Aqueous extract:		
Lime	1.2440	
Magnesia	.0900	
Potash and soda	.0002	
Chlorine and phosphoric acid	traces.	
		1.3242
III. Carbonic acid		37.8340
IV. Chlorohydric extract:		
Lime	27.6920	
Oxide of iron	.1505	
Protoxide of manganese	.0165	
Phosphates of iron and alumina	traces.	
Magnesia	2.2783	
Potash	.1164	
Soda	.4218	
		30.6755
V. Insoluble in hydrochloric acid:		
Protoxide of iron	.0937	
Lime	.0063	
Magnesia	.0001	
Silica	.1344	
		.2345
		100.0000

Calcareous tufa frequently occurs in the lower peninsula, varying from a porous, spongy mass, to a hard, stratified lime rock.

From the generally calcareous nature of the rocks of Michigan, great fertility of soil would be naturally expected, and such is the case, at least in the lower peninsula. Rich oak openings and small prairies constitute much of the soil. Upon this subject the authority heretofore so often quoted says:

The Drift, especially in most parts of the lower peninsula, abounds in calcareous pebbles and large boulders, whose constant, slow solution affords an unfailing and literally inexhaustible supply of calcareous matter. These calcareous debris are, of course, most abundant in the regions underlaid by limestone outcrops, and in the districts immediately south of these. The great drift agencies, however, have given them a very wide and general distribution over the peninsula. In consequence of this we scarcely find in the peninsula any purely siliceous soils. Even those composed of (apparently) pure sand are made up largely of comminuted limestones. Hence we witness the anomaly of luxuriant farm crops and orchards upon soils which an ordinary observer would pronounce little else than sterile sands.

Analyses of Michigan brines.

Localities.	Specific gravity.	Chloride of sodium.	Chloride of calcium.	Chloride of magnesium.	Sulphate of lime.	Sulphate of magnesia.	Carbonate of lime.	Compounds of iron.	Total solid matter.
Saginaw City, Michigan salt group.	1.1801	19.246	2.395	1.804	.534	....	....	.064	24.043*
Bay City coal measures	1.163	19.192	.742	.432	.145	....	....	....	20.511†
Port Austin, salina group.	1.177	17.6161	3.1274	1.5675	.0129	....	....	....	22.3239‡
Grand Rapids, Michigan salt group, (weak, not for salt making.)	1.0175	1.737	.276	.072	.131	.005	.001	....	2.229§

* Prof. A. Dubois. † Prof. J. R. Chilton. ‡ Dr. Goessman. § Prof. L. R. Fisk.

Analyses of Michigan limestones.—(Foster and Whitney.)

	Laurentian, Carp River, Lake Superior.	Calciferous sand-rock, township 46, range 18.	Calciferous sand-rock near L'Anse, Keweenaw Point.		Calciferous sand-rock below forks of Escañaba River.	Cincinnati group, Little Bay des Noquets.	Clinton, east side, Green Bay.	Niagara, east side, Big Bay des Noquets.	Niagara, south side, Sturgeon Bay.	Salina, Mackinac Island.
Insoluble								3.93		
Siliceous matter	14.53	14.34	5.32	5.41	37.62	29.36	30.22		.57	5.65
Alumina			1.82	.83	.15			.24		.31
Protoxide of iron			1.64		.45	2.28	1.54			
Carbonate of iron.	.49	4.74								
Carbonate of manganese.										
Carbonate of lime.	46.14	76.36							54.17	
Lime			28.58	28.97	14.16	22.65	25.55	29.16		48.88
Carbonate of magnesia.	38.01	5.02.							44.39	
Magnesia			17.89	19.92	15.51	12 21	15.49	20.66		3.03
Carbonic acid				44.34	28.21	30.89	29.84	44.11		41.42
Chloride of sodium										Tr.
Sulphuric acid	Trace				Trace..	Trace.	Trace	Trace..		
Chlorine					.05			Trace..		
Soda					Trace..	.24	1.02	.23	.87	
Water	.83			.53	3.85	2.37		1.67		
Loss										.71
	100.00	100.46	55.25	100.00	100.00	100.00	103.66	100.00	100.00	100.00

ILLINOIS.

The northern counties of Illinois, comprising about one-fifth of the State, are based on rocks of the Silurian age. The lower Silurian formations, so prominent in Wisconsin and Minnesota, have their southern extension in the north-western and northern central part of Illinois, reaching much farther toward the south in the latter than in the former situation. These rocks include the Lower Magnesian limestone, or Calciferous Sand-Rock of the New York survey; the overlying St. Peter's sandstone, so called by Professor D. D. Owen; the Trenton limestone group, in which Professors Meek and Worthen include the Galena and Blue and Buff limestones of the lead region; and, lastly, the Cincinnati group. As their names import, the first and third of these groups are calcareous. The Cincinnati group, in the lead region, presents argillaceous, bituminous, and sandy shales with thin bands of limestone; at other points, as in Kendall County, it is chiefly a lime-rock; while again, in the isolated outcrops of Silurian strata, which occur in the portion of the State south of the Silurian district above described, it completely changes its lithological character and appears as a heavy bedded sandstone overlaid by limestone.

The lower Magnesian limestone has, so far, been found in La Salle County only. The Trenton has been observed in the counties of Jo Daviess, Stephenson, Winnebago, Carroll, Ogle, Lee, and La Salle, and near the Mississippi River, in Calhoun, Jersey, Monroe, and Alexander. Exclusive of the extensive workings, made for the extraction of lead ore from the Galena member of the group, in the counties of Jo Daviess, Stephenson, and Carroll, it has been quarried on a large scale near Rockford, and at Homer, La Salle County. Many of the layers are available for the manufacture of lime, and of its development in Calhoun County Professor Worthen remarks that the whole thickness of the formation, not less than three hundred feet, is of good quality for this purpose.

The upper Silurian strata of Illinois belong chiefly to the Niagara group. This occurs in the counties of Cook, Will, Dupage, Kendall, Kane, Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Rock Island, as a brown dolomite with intercalated beds of massive gray limestone, which is sometimes cherty and at others quite free from siliceous matter. At Port Byron, Rock Island County, and at Bridgeport, near Chicago, the Niagara limestone has been extensively burned for lime, and is quarried for building and lime at Athens and Joliet, being shipped from the latter place to points throughout the northern and central parts of the State. In the more southern counties the Niagara group outcrops in Pike, Calhoun, and Jersey, and large quarries have been opened in the last-named county.

In the counties of Jackson, Union, and Alexander, in the southern extremity of Illinois, a group of strata appears, described in the first volume of the geological survey of the State as the Clear Creek limestones, and consisting of a coarse, bluish-gray limestone, covered by beds of a mottled compact marble, and this again underlying the great mass of the formation, which is of yellowish, gray, siliceous limestone, in thin beds. The lower division of these Clear Creek limestones has been finally decided to belong to the lower Helderberg of the Silurian, and the upper to the Oriskany of the Devonian.

Other developments of Devonian rocks appear in Illinois as the Black Slate; a series of dark colored, often bituminous shales, equivalent to the Hamilton shales of States farther east. These outcrop in the counties of Pike, Calhoun, Jersey, and Union. Lying below these is a series of limestones and calcareous shales, called, in the survey of Illinois, simply Devonian limestone, as being the only purely calcareous rock of that age within its limit. These limestones are believed, by the director of the survey, to include strata of both Hamilton and upper Helderberg, and outcrop extensively in Rock Island County, where they include beds of an almost pure carbonate of lime and are largely quarried. South of Rock Island they appear again in the counties of Calhoun, Jersey, and Union; in all affording good material for the manufacture of lime.

The Kinderhook group before alluded to, if established, and it appears to be generally accepted, will include not only the Waverley sandstones of Ohio and Indiana, but the Goniatite limestone of Jackson County in the latter State, the Choteau limestone, Lithographic limestone, and Vermicular sandstones and shales of the Missouri report and the rocks referred by Professor Hall, in the Iowa report, to the horizon of the Chemung. The Kinderhook group in Illinois has its greatest development along the western border of the State, in the counties of Henderson, Pike, Calhoun, and Jersey, where it includes limestones, shales, and grits; the limestone often oölitic. It has not been met with north of Henderson County, and is considered as represented in the Sub-Carboniferous series of Tennessee and Alabama by a portion of the Siliceous group of Professor Safford. In addition to the Kinderhook group, the Sub-Carboniferous formation of Illinois includes groups known as the Burlington, Keokuk, St. Louis, and Chester, the first being geologically the oldest, and all more or less calcareous. The Burlington group consists of limestone only, in its lower beds magnesian, and in its upper, when free from chert, nearly pure carbonate of lime. It is well exposed in the counties of Henderson, Warren, Adams, Pike, Calhoun, Jersey, Monroe, and Jackson. The Illinois survey says of this group:

This limestone formation is a very important one, both for the amount of excellent building stone which it affords, as well as an inexhaustible supply of limestone suit-

able for the manufacture of quicklime, and in these respects its value is not excelled by any member of the Mountain Limestone series of equal thickness.

The lowest member of the Keokuk group consists of thin layers of light gray limestone alternating with chert and honestone; the middle division is a gray limestone extensively quarried at Hamilton, Nauvoo, and Niota, Hancock County, and also near Quincy, yielding lime of excellent quality. The upper division is well known as the Geode bed, and affords beautifully crystallized siliceous geodes, often hollow, in enormous quantity. These geodes are imbedded in a shaly limestone with occasional layers of shale. The divisions of the Keokuk are recognizable only in the north-western outcrops of the group from the north line of Hancock County to the mouth of the Illinois River. Below the latter point the geode bed has not been distinguished, and in Alabama and Tennessee the formation merges into the Siliceous group of Safford. The St. Louis limestone varies in character at different points. At Alton it is evenly bedded, sometimes concretionary brecciated, or oölitic. In the southern part of the State, as in Hardin County, it is cherty in its lower beds and oölitic above. In Hancock County the upper part of the group is concretionary, while the lower is shale. This group affords the best material for the manufacture of lime that is found in the State. At Alton, where it has long been extensively worked for this purpose, there were manufactured from March to November, 1857, 121,900 barrels of lime. Since that time, however, the amount manufactured has decreased, owing to the opening of new sources of lime nearer to the points where it is consumed.

The Chester group comprises limestones, shales, and sandstones, and is confined to Madison and counties south of it. Much of the limestone of this group is argillaceous, though there are occasional localities where it is available for lime burning.

Generally speaking, the Sub-Carboniferous formations of Illinois are confined to the counties along the Mississippi below Rock Island, and to those upon the Ohio as far north as Hardin. They border in these directions the great Illinois coal field, which covers more than two-thirds of the entire State, and thin out toward the north, where the Coal Measures appear to rest directly upon the upper Silurian.

The Coal Measures include strata of limestone throughout their whole extent, many of which are available for economic application, though the beds are seldom of great thickness.

In the counties of Alexander, Pulaski, Massac, and Pope, the Tertiary system is represented by stratified sands and clays, with gravel, sandstone and ferruginous conglomerates. A bed of greenish marly sand in Pulaski County was, from its physical resemblance to the Cretaceous greensand of New Jersey, at first ascribed to the horizon of that formation. It is now considered from the evidence of its fossils to be Tertiary. Chemical analysis of it is desirable, in view of the fact that greenish marls, containing a valuable proportion of glauconite, occur in the Tertiary further south.

The Post Tertiary formations of Illinois consist of Drift and alluvium, including in the former the Bluff or Löess formation before noticed. The Drift deeply covers much of the northern portion of the State, and consists of blue clay, gravel, and occasional boulder-beds. The Bluff or Löess is found, as in Missouri, along the more prominent river banks, and is believed to be the result of modification of the Drift by lacustrine action subsequent to its deposition.

Little can be said upon the relations of the geological formations of Illinois to the soil of the State, which has not already been covered by

remarks on other Western States. The recent formations, including in these the prairies, are so deep that the basis rocks have, perhaps, even less to do with the character of the soils in much of Illinois than in either Northern Indiana, Northern Ohio, or Michigan.

Analyses of Illinois limestones.

	*Hancock County.	*Will County.	*Pike County.	*Jersey County.	*Alexander County.	†La Salle County.	†Union County.
Carbonate of lime	82.48	41.92	61.60	47.79	98.01	43.50	89.26
Carbonate of magnesia	......	40.51	33.14	42.86	1.59	30.07	9.30
Alumina	2.10	......	} 1.60	} 1.40	.20	20.00	} 1.40
Oxide of iron		1.77				2.00	
Clay and insoluble matter	......	......	......	......	......	......	......
Insoluble silica, &c	12.50	14.73	3.35	5.60	.06	1.00	......
Potash	......	......	......	......	......	.18	......
Alkalies and loss	......	......	......	......	......	......	......
Water and loss	2.92	1.07	.31	2.35	1.07	3.25	......
Total	100.00	100.00	100.00	100.00	100.93	100.00	99.96

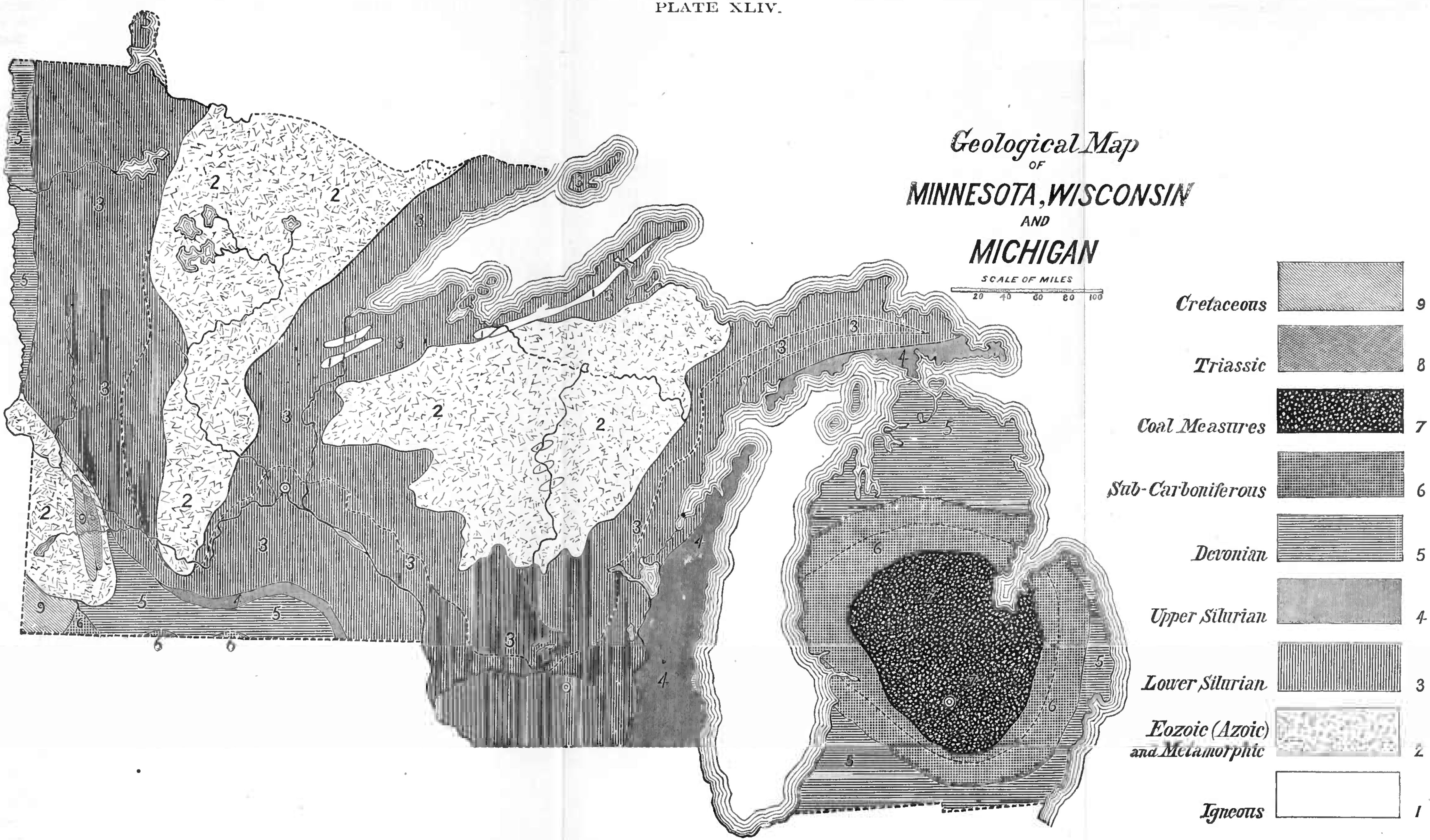
	*Hardin County.	‡Greene County.	‡Greene County.	‡Kane County.	‡Jersey County.	‡Cook County.	‡Jackson County.
Carbonate of lime	90.86	44.90	30.70	40.86	59.30	31.60	37.25
Carbonate of magnesia	3.18	25.44	16.31	43.54	16.08	22.24	60.00
Alumina	} 1.06	......	......	......	......	......	......
Oxide of iron		5.21	2.75	1.40	1.00	1.20	.80
Clay and insoluble matter	......	23.49	48.53	11.60	23.13	43.56	1.56
Insoluble silica, &c	2.72	......	......	......	......	.16	......
Potash	......	......	......	......	......	......	......
Alkalies and loss	......	.96	.49	2.60	.49	1.30	.39
Water and loss	2.18	......	......	......	......	......	......
Total	100.00	100.00	98.78	100.00	100.00	100.06	100.00

* Prof. Pratten. † Professors Blaney and Mariner. ‡ Prof. J. V. Z. Blaney.

IOWA.

The lowest formation in Iowa is the Potsdam sandstone of the lower Silurian. This outcrops, to a very limited extent, along the water courses in the extreme north-eastern corner of the State. Next above this in the geological series occurs the St. Peter's sandstone. This is confined to the counties of Allamakee and Winneshiek. South-west of this the formations are disposed in nearly parallel belts, having a general direction north-west and south-east. The first of these belts is of limestones of the lower Silurian age, and in its north-eastern portion assigned by the survey of Professors Hall and Whitney to the period of the Trenton, while the remainder is called Galena. It will be remembered that in the more recent survey of Illinois these are considered as one group, under the name of Trenton. The limestones just described are bordered on the south-west, through the counties of Jackson, Du-

PLATE XLIV.


Geological Map
OF
MINNESOTA, WISCONSIN
AND
MICHIGAN
SCALE OF MILES
20 40 60 80 100
Cretaceous 9
Triassic 8
Coal Measures 7
Sub-Carboniferous 6
Devonian 5
Upper Silurian 4
Lower Silurian 3
Eozoic (Azoic) and Metamorphic 2
Igneous 1

buque, Clayton, and Fayette, by a narrow outcrop of shales, which the Iowa survey described as being equivalent to the Hudson River group of New York, but which more properly belong in the since proposed Cincinnati series. Still south-west of the shales upper Silurian strata appear, occupying a district probably extending from the Minnesota line to the Mississippi River, very narrow at its northern extension, but, on the river, including nearly the whole of the counties of Jackson, Clinton, and Scott. The upper Silurian strata of Iowa were also subdivided by the survey of that State into the Niagara and a new group called the Le Claire. These two have been reunited by the Illinois survey as properly belonging to the Niagara only.

The next series of rocks outcropping in Iowa, and still, in their general development, parallel to the last described formations, are of the Devonian age, and of the upper Helderberg limestone group. South-west of these again are limestones and shales of the Hamilton group, and oölitic limestone, with sandstones and shales, the Chemung of Hall and Whitney, and the Kinderhook of Meek and Worthen. These, together, constitute a broad belt from thirty to forty miles wide, which is marked as Devonian upon the accompanying map. The dotted line upon this formation may indicate somewhat the extent of the Kinderhook group, which is accepted by Dr. White, the present State geologist of Iowa. The remainder of the State, not already described, with the exception of some Cretaceous strata in the extreme west and north-west, is occupied by the Coal Measures and their underlying limestones and sandstones, the subdivisions and character of which are essentially the same as just detailed under the head of Illinois.

The Coal Measures present rather more and thicker beds of limestone than in Illinois and eastward, some of the more western strata of which were thought by Professor Hall to be equivalent to the Permian series of Europe, but which are now considered as true Coal Measures formations.

The Cretaceous formation of Iowa includes, according to Professors Meek and Hayden, sandstones, impure lignitic beds, and soft chalk-like marls in great quantity, which are nearly pure carbonate of lime. It is probable that of the accompanying map the western section, at least, will require to be materially modified upon the publication of the geological survey of Iowa by Dr. White, soon to be issued, and that the area devoted to the Cretaceous series especially will demand alteration.

The Drift covers, more or less deeply, the entire State of Iowa, and, as in Illinois, Missouri, and further south, presents itself in certain localities along the streams as Bluff or Löess. The remarks made upon the soil and prairies of Illinois apply with equal force to those of Iowa.

An examination of the reported localities in Iowa of limestone fit for economic application reveals so many that the following remarks of Professor Whitney upon the subject seem fully sustained:

> The materials for burning into lime are found in every part of the State of Iowa, where there are any rocks exposed, without the necessity of going to any considerable distance. The kilns are usually located with reference to abundance and convenience of fuel rather than of rock. The Trenton, Hamilton, and Carboniferous groups contain masses of nearly pure carbonate of lime. The magnesian limestones are also largely burned for lime.

A notice of the mineral fertilizers of Iowa would be incomplete without mention of the extensive gypsum beds of Fort Dodge. These, though found exposed in a very limited area, are so massive (one meas-

ured bed being twenty-eight feet in thickness) that the supply will probably prove boundless. The gypsum outcrops upon the Des Moines River and its tributaries in the immediate vicinity of Fort Dodge. This mineral has been quarried to but limited extent as yet, but as it is of fine quality, both for mechanical and agricultural purposes, the beds will, in all probability, be soon more fully developed. An analysis of the gypsum from Fort Dodge, by Professor D. D. Owen, gave:

Sulphate of lime	70.8	Water	20.0
Silicate of lime	2.2	Potash and soda, with chlorine and sulphuric acid	0.3
Carbonate of lime	2.0		
Phosphate of lime	1.1		
Insoluble	2.0		99.1
Magnesia	0.7		

Analyses of limestones of Iowa.—(J. D. Whitney.)

	Clayton County—Trenton group.	Allamakee County—Trenton group.	Dubuque County—Galena group.	Jackson County—Niagara group.	Fayette County—Niagara group.	Scott County—Le Claire group.
Insoluble in hydrochloric acid	18.36	4.07	2.46	.96	4.16	.42
Alumina					} 1.01	.53
Oxide of iron	} 1.69	.62		.72		
Carbonate of iron			} 1.35			
Manganese						
Carbonate of lime	44.90	94.08	52.00	54.76	66.01	57.54
Carbonate of magnesia	34.23	1.23	43.93	43.46	28.52	41.51
Bituminous matter						
Sulphuric acid and chlorine						
Potash						
Soda			.26	.18	.25	
Loss	.82				.05	
Total	100.00	100.00	100.00	100.08	100.00	100.00

	Buchanan County—Hamilton group.	Floyd Co.—Hamilton group.	Mitchell County—Hamilton group.	Blackhawk Co.—Hamilton group.	Henry Co.—Concretionary Carb.	Hardin Co.—Lime in Coal Measures.	Van Buren Co.—Lime in Coal Measures.
Insoluble in hydrochloric acid	10.02	6.56	2.52	2.10	2.05	8.04	3.57
Alumina		} 1.01				.35	
Oxide of iron	} .98		} .48	.16	.29		} .56
Carbonate of iron						} 3.00	
Manganese							
Carbonate of lime	87.95	55.09	81.66	97.48	96.84	85.74	93.14
Carbonate of magnesia		37.34	15.72		.73	1.00	1.45
Bituminous matter						1.09	.56
Sulphuric acid and chlorine							.51
Potash			} .19				} .21
Soda				.26	.26		
Loss	1.65		.03			} .78	
Total	100.00	100.00	100.00	100.00	100.17	100.00	100.00

The concretionary (St. Louis) limestone of Henry County may be taken as affording a fair index of the composition of this rock in other localities.

WISCONSIN.

The rocks of the State of Wisconsin and of the upper peninsula of Michigan are, with the exception of a very limited development of

Devonian strata in the immediate vicinity of Milwaukee, of the Eozoic and the Silurian age. A great field of the former, indicated upon the map accompanying the report of the Canada survey as Huronian, but described as Laurentian by Professor Winchell, extends from the shore of Lake Superior, between Marquette and Keweenaw Bay, south and west, covering the greater part of the north-western portion of the upper peninsula of Michigan and the whole northern central part of Wisconsin. This is surrounded on all sides, except where it abuts upon Lake Superior, by a wide irregular belt of Potsdam sandstone, which, with the exception of some igneous outcrops on Keweenaw Point and on the coast immediately west of this locality, is the only rock lying to the north of the Eozoic formations. The Potsdam sandstone is succeeded by magnesian limestones belonging to the Calciferous Sand Rock of the New York survey; these lie very irregularly disposed along the Mississippi River and between its tributaries from St. Croix as far south as Grant County, thence crossing the State to the eastward, they occupy much of the counties of Richland, Sauk, Iowa, Dane, and Columbia, with the north-western corner of Jefferson County, and the western part of Dodge, from whence they extend north-east through the counties of Green, Lake, Winnebago, and Outagamie, and the south-eastern part of Shawanaw and Oconto, to the Michigan line, whence they extend parallel with the general direction of the peninsula, through its center, to its eastern end. South and east of this belt of magnesian limestone occur the Galena and Trenton limestones, mainly in the counties of Grant, Iowa, La Fayette, Green, Rock, Walworth, Jefferson, Dodge, and Fond du Lac, eastern Winnebago and Outagamie, and the lake border of Shawanaw and Oconto. From this point they extend parallel with the magnesian limestones through the upper peninsula of Michigan. In the southern part of Dane County, as well as in the eastern part of Green and western of Rock, the St. Peter's sandstone outcrops extensively, and also along the water-course in the neighboring counties Above the Galena limestone, and separating it from the succeeding upper Silurian strata, occur shales of the Cincinnati group, the Green and Blue shales of the Wisconsin survey. These appear occasionally throughout southern Wisconsin, and form a narrow belt, parallel with the eastern development of the lower Silurian formations, from the Illinois line nearly to Sturgeon Bay. In the peninsula this group re-appears upon Big Bay des Noquets, being classed by Professor Winchell as Hudson River. In Wisconsin, between the belt of shales just described and the lake shore, the rocks, with the exception of the Devonian around Milwaukee, are of the upper Silurian age, and of the Niagara epoch, including the Racine limestone of Professors Lapham and Hall under this designation. This is everywhere dolomitic and extends in Wisconsin from the Illinois border to the limit of the peninsula between Lake Michigan and Green Bay, and again appears in Michigan on the east side of Big Bay des Noquets, whence it skirts the lake to Drummond Island. The Niagara limestone also caps many eminences in the southern and south-western portion of the State, but nowhere is developed *in extenso* outside of the belt described. The Devonian strata of Wisconsin are confined to an area around Milwaukee, ten miles long from north to south, and six to seven miles wide. The inland margin of this area is formed by an outcrop of shaly limestone belonging to the Onondaga salt group, which again appears in Michigan just north of the Straits of Mackinaw. This underlies a pyritous limestone and some shaly beds of the upper Helderberg and Hamilton formations. The more northern portion of Wisconsin is so

little known that it can only be assumed that limestones exist in the Eozoic, as in Canada and Michigan. The area covered by the Potsdam sandstone, indicated upon the accompanying map by a dotted line separating it from the magnesian limestone of the Calciferous formation, yields no fertilizing agent of value. The Calciferous limestone is often intimately blended with the underlying sandstone, rendering it siliceous or cherty, and is always dolomitic. The Trenton limestone in its lower beds has generally the character of an impure dolomite, while its upper, immediately underlying the Galena limestone, are often calcareous and pure. The Galena limestone is magnesian, compact and generally pure. Gypsum is mentioned by Professor Lapham, in one of his earlier works, as occurring in Brown County, but has not been found in sufficient mass to assume any importance. Calcareous tufas are found throughout the limestone regions, and are of every grade of consistence, from porous friability to flinty hardness and solidity. In some of the counties located upon the Potsdam sandstone, lime is quite extensively manufactured from the calcareous nodules of the Drift.

The soil of Wisconsin, in its northern and eastern counties, has been subjected to the modifications produced by Drift. In the south-western part of the State, however, there is a remarkable driftless region, which extends in from Chippewa River, in Eau Claire County, south-east to central Sauk County, and thence south into Illinois, where it includes a part of the lead region. This absence of Drift also characterizes the north-eastern counties of Iowa and the south-eastern part of Minnesota. Throughout the whole region thus roughly described the soil must, of course, be derived directly from the subjacent rocks, and so varies with their character.

Analyses of Wisconsin limestones.

Localities.	Carbonate of lime.	Carbonate of magnesia.	Alumina, carbonate, and oxide of iron.	Insoluble silica and alumina.	Chlorine, sulphuric acid, soda, water, and loss.	Total.	Authority.
Crawford County	46.98	37.55	0.67	14.26	0.54	100.00	J. D. Whitney.
Lafayette County	97.92	1.60	0.28	0.82	....	100.62	Do.
Lafayette County	49.75	27.49	6.54	16.22	....	100.00	Do.
Grant County	49.40	41.33	0.60	8.47	0.20	100.00	Do.
Iowa County	59.95	34.65	2.14	3.00	0.26	100.00	Do.
Iowa County	69.79	4.02	7.02	6.75	....	87.58	Do.
Sauk	50.00	41.70	2.60	3.10	2.60	100.00	B. F. Shumard.

MINNESOTA.

No regular geological survey of Minnesota having been undertaken as yet, we are dependent for our knowledge of its formations upon the report of Professor Owen upon Wisconsin, Iowa and Minnesota, made to the General Land Office in 1850-'51, and such isolated observations as have been recorded since. The map accompanying this report is therefore mainly hypothetical save in the south-eastern portion of the State, which was explored by Professor Owen. It is, however, based upon the map executed by Professor Hall for the Canada survey, and represents pretty accurately the present state of the knowledge of the geology of Minnesota. Along the Mississippi River, in the space upon the map included in a dotted line, occurs the Calciferous magnesian limestone found also in Wisconsin, and, as there, based upon the Potsdam

sandstone. The remainder of the map, in the absence of exact boundary lines, explains itself sufficiently, with the exception of the isolated development of Cretaceous and Triassic (?) strata in the south-western portion of the State. This was observed by Professor Hall in 1865, and described by him in the Transactions of the American Philosophical Society for 1869. These formations appear to lie in an eroded synclinal or trough of quartzite of the Huronian age, and may or may not be continuous with the Cretaceous strata of Iowa. The more eastern formation is not definitely assigned to the Triassic by Professor Hall, but he suggests that both this and the gypsum beds of Iowa may belong to that, or some other group, between the Coal Measures and the Cretaceous.

Limestones of the Eozoic age are found, so far as known, more or less throughout the strata of that series. The lower Silurian includes the Potsdam sandstone, the Calciferous limestone mentioned above, the St. Peter's sandstone, and at St. Paul and the Falls of St. Anthony, the Trenton limestone. The Calciferous limestone is the most extensive of the calcareous rocks of the Silurian age, and the soil produced by its decomposition is not excelled in the State.

Marls (recent) are said to exist to a large extent, but no localities are reported. Such analyses of Minnesota limestone as are accessible are presented below.

Analyses of Minnesota limestones.

	Upper St. Croix.*	Shore of Lake Pepin.*	Lake St. Croix below Stillwater.*	Gray Cloud Island.*	Thirty miles below Pepin.*	Cape Winnebago.†	Near St. Peter's.†
Carbonate of lime	48.24	52.00	48.30	51.40	29.70	50.93	36.40
Carbonate of magnesia	42.43	42.20	36.80	40.70	9.70	41.13	0.40
Oxide of iron, alumina, and oxide of manganese.	6.14	0.90	4.30	4.60	0.90	1.74	12.40
Insoluble, (in hydrochloric acid?)	2.74	4.30	6.90	Trace.	60.00	4.84	29.00
Water	0.40	0.60	3.70	3.30	....	0.50	18.00
Loss	0.05	0.60	3.70	3.30	....	0.86	3.80
Total	100.00	100.60	103 70	103.30	100.30	100 00	100 00

	Red River, twenty miles below Assiniboin.†	Red River, twenty miles below Assiniboin.‡	White Rock Bluff, St. Peter's River.‡	Half-mile below Fort Snelling.†	Half-mile below Fort Snelling.†	Quarry Cr'k, near Parkhurst, Mississippi Riv.†
Carbonate of lime	53.70	78.10	58.65	64.85	42.60	52.15
Carbonate of magnesia	40.50	17.80	29.15	13.75	28.46	42.10
Oxide of iron, alumina, and oxide of manganese	4.00	1.49	1.55	7.50	7.83	1.90
Insoluble, (in hydrochloric acid?)	0.80	0.10	7.25	12.40	14.16	1.20
Water	1.00	1.70	2.65	1.25	5.33	1.55
Loss	1.00	1.70	0.75	0.25	1.60	1.10
Total	101.00	100.80	100.00	100.00	99.98	100.00

* Prof. J. G. Norwood. † Prof. D. D. Owen. ‡ Prof. B. F. Shumard.

FACTS CONCERNING OREGON.

The isolation of Oregon has prevented a rapidity of settlement, which its manifest advantages of soil, and climate, and minerals appear to warrant. These advantages are set forth under the authority of the Board of Statistics and Immigration of Portland, Oregon, by its secretary, John W. Drake, whose statements are indorsed by Hon. H. W. Corbett, and are here presented as the most recent facts concerning the agriculture and other resources of this interesting State.

Oregon lies between the forty-second and forty-sixth parallels of north latitude, and between the one hundred and seventeenth meridian west from Greenwich and the Pacific Ocean. The State has an average length, east and west, of about three hundred and fifty miles, and a breadth, north and south, of two hundred and seventy-five miles, and contains 96,250 square miles, or 61,600,000 acres of land. It embraces more territory than the States of New York and Pennsylvania combined. In population it does not exceed one hundred and twenty thousand inhabitants, while the two States just named contained, according to the census of 1860, an aggregate population of nearly seven millions. Of the entire area of the State, about 25,000,000 acres are adapted to agriculture, and about the same quantity to grazing purposes, the remainder being mountain land, valuable only for its immense forests of timber. Of the agricultural and grazing lands, not over six per cent. has passed from the government into the hands of private parties, and the quantity under cultivation would not exceed two per cent.

The Cascade range of mountains, crossing the State from north to south, divides it into two main divisions, the eastern and western, each division having its own distinct peculiarities of climate, soil, and topography. In the western division, lying at the base of, and in a general parallel direction with, the Cascade range, are three large fertile valleys, separated from each other and from the sea coast by low ranges of mountains. Taken together, these valleys form a continuous chain of settlements from Northern California to the Columbia River, the northern boundary of Oregon. The Willamette Valley, the largest of the three, occupies the northern part of the western division, with its waters flowing into the Columbia, and navigable the entire length of the valley. The Rogue River Valley lies in the southern part, and the Umpqua Valley between the two. The waters of Rogue River and the Umpqua break through the Coast range, discharging into the ocean. Rogue River is not navigable, but the Umpqua is navigable for light-draught vessels to Scottsburg, twenty-five miles from its mouth; recent attempts to navigate it forty miles further up have met with fair success. The valley of the Willamette contains the oldest settlements in Oregon. It is one hundred and twenty-five miles long, and has a breadth of about forty miles; and in view of all its advantages of soil, climate, and marketing facilities, is justly considered to be the finest and best agricultural region of the Pacific slope. The area of its arable lands is sufficient for the support of a million people. Its present population does not exceed eighty thousand. The river flowing through its center drains a large part of the mountain system of Oregon, and with its innumerable tributaries and rivulets furnishes the valley with a constant supply of the best mountain water for agricultural purposes, and with water-power for the use of mills and factories. The Umpqua and Rogue River Valleys are equally well watered, but are much smaller and of more irregular and uneven surface.

Western Oregon, throughout its mountain ranges and along the coast, is heavily timbered, while the valleys consist of alternate stretches of timber and prairie.

Cedar, pine, fir, hemlock, spruce, oak, ash, alder, soft maple, and balm, or cotton-wood, are the principal varieties of timber adapted to the farmer's use.

Eastern Oregon is on an elevated plateau, intersected with numerous water-courses flowing in a general northerly direction into the Columbia. The Klamath Basin, situated in the south-western corner of this division, discharges its waters through the rivers of Northern California. An elevated range, called the Blue Mountains, crosses Eastern Oregon diagonally, from north-east to south-west, spreading out its spurs in all directions across the central and southern parts of that division. This division of the State has a number of fine valleys, including the Grande Ronde, Powder River, Umatilla, and John Day Valleys, in the northern part; the Harney Lake Valley in the central part; the Link River, Lost River, Sprague River, and other valleys of the Klamath Basin. It has no navigable rivers except the Columbia on its northern border. The valleys and table-lands of this division, comprising more than two-thirds of its entire area, are prairie lands. Timber of excellent quality, embracing several varieties of pine, fir, larch, and cotton-wood, grows on the high ridges of the mountain ranges, and along the water-courses. As a general thing it is convenient of access from the valleys, supplying the settlers with abundant materials for fencing and building purposes. No

hard wood is to be found anywhere in the forests of Eastern Oregon, except at two or three spots along the foot-hills of the Cascade Mountains, a scattering growth of oak of an inferior quality for mechanical purposes.

The settlements in Eastern Oregon are confined to the valleys of the northern part and to the mining regions; even there they are quite sparse.

This part of the State has an extensive mining territory, very much of it still undeveloped, and capable of affording employment for labor and capital for many years at remunerative rates. The mining population makes a home market for the products of the farms and dairies of the adjacent valleys, an important fact in forming an estimate of its agricultural advantages.

SOIL AND PRODUCTS.

The valleys of Western Oregon have an undulating surface, so much so, in some places, as to become hilly, while in others there are broad tracts of land comparatively level. This irregularity of surface occasions frequent alternations of upland and meadow, of timber and prairie, so that a majority of farms have a portion of each. Springs and running brooks supply the farmers with pure water for all household, dairy, and stock purposes. In the upper part of the Willamette Valley is an extensive district of smooth prairie land, intersected with water-courses and groves of timber; and further down the valley are several smaller prairies, skirted with heavy bodies of timber. The same conditions exist in the Umpqua and Rogue River Valleys, but with the difference that the prairies are smaller in size. The prairie lands just described, together with the gentle slopes of the valleys, are the principal grain lands of Western Oregon. They have a rich soil of dark, sandy loam, very productive, and, generally speaking, easy to cultivate. The products of this kind of land are wheat, oats, corn, barley, rye, buckwheat, flax, timothy, clover, potatoes, fruit trees, and garden vegetables. Frequent depressions or swales occur, of a stiff, black soil, adapted to grass, making excellent meadows when cultivated and seeded to timothy. The hilly portions of the valleys have a soil of dark clay loam, with intervening valleys of sandy loam and vegetable mold, making good grass land, well adapted to grazing purposes, and superior for fruit growing. Some of the hilly sections produce a better quality of wheat than even the finest prairie lands, although the yield is not quite so large.

In the northern part of the Willamette Valley is an extensive district of country, heavily timbered on the uplands with fir, hemlock, and cedar, and on the swales and creek bottoms with ash, alder, vine, maple, and various descriptions of undergrowth. These are among the best lands of the State for grain, grass, fruit trees, and especially for all kinds of root crops and garden vegetables. The mountain lands of the coast range are heavily timbered, as a general thing. They have a mellow, loamy soil, extending in most places to the summits of the ridges. On the western slope of this range, along and near the coast in several places, there are quite extensive districts of high, rolling hills destitute of timber and supporting a heavy growth of grass; while the intervening creek bottoms have a rich, black soil of great depth. Tide and marsh lands are of frequent occurrence on the coast, producing a fine quality of grass. On Coos Bay, and in that vicinity, are extensive bodies of this kind of land. The grass lands along the coast cannot be excelled in any country for general stock-raising purposes, while the creek bottoms and benches hardly have an equal for productiveness in all kinds of farm crops.

Wheat and oats are the leading grain crops of Western Oregon. Climate and soil seem to have a special adaptation to their growth and to the maturity and perfection of the grain. Corn and barley are cultivated to some extent, and good crops of both have been raised in the valleys; but with exceptions in favor of a few localities, they are not regarded as being adapted to the climate. In Rogue River Valley, however, barley makes a good crop, yielding thirty to fifty bushels per acre, and corn is grown every year in some parts of the Willamette and Umpqua Valleys. In the Willamette Valley rye and buckwheat are raised to a small extent, equal, probably, to the demands of the market. The yield per acre is from twenty-five to thirty bushels for rye, and forty to fifty for buckwheat. The buckwheat flour of the Willamette Valley is superior to that of any other section on the Pacific slope.

Wheat is a sure crop anywhere in Western Oregon. It is free from the ravages of insects, rust, blight, and other deleterious influences common to some sections of the United States. Several varieties of both winter and spring wheat are cultivated; both do well. Winter wheat is put in the ground in October or November, and spring wheat from February to May, according to season, condition of ground, &c. The yield per acre ranges from twenty to forty bushels, ordinarily. Many good farmers claim that with reasonably good cultivation an average of thirty bushels, one year with another, can be depended on. In the history of the white settlement of Western Oregon, extending over a period of about thirty years, there has never been a failure of the wheat crop; and only twice during that time was there sufficient rain in harvest time to damage the crop. The quality of the grain is superior. It attains to more than the ordinary weight per bushel, and makes a quality of flour that commands the highest

prices in San Francisco and New York. Frequently the San Francisco market reports quote the flour of some of the principal mills of Oregon at figures above anything of California manufacture. A cargo of wheat shipped in the spring of 1869, by a business firm of Portland, to Liverpool, entered into competition with wheat from all parts of the world, and brought the highest price current at the time.

Oats are the principal grain raised for feed, particularly in the Umpqua and Willamette Valleys. They are always a sure crop, and yield fifty to one hundred bushels per acre. A large quantity is shipped every year to San Francisco, where they sell from 10 to 15 cents per hundred pounds higher than those produced in California.

As an example of the productiveness of Western Oregon of the two leading grain crops, an extract is here given from an address delivered by A. J. Dufour, late president of the Oregon State Agricultural Society, before the American Institute Farmers' Club, in New York City, September 25, 1869:

"Allow me to cite some well-authenticated facts to prove the fertility of our Oregon lands. In Linn County, as president of the Agricultural Society of the State, I had the pleasure of awarding the premium to a farmer who raised eighty-two bushels of oats to the acre, weighing forty-three pounds per bushel; for the best ten acres in oats, a premium for seventy-eight bushels per acre, weight, forty-one pounds per bushel; for the best ten acres of wheat, showing forty-eight bushels per acre; and to another farmer, a premium for a field of oats measuring eighty-five bushels to the acre. In Marion County, the average yield of wheat is thirty-three and a third bushels per acre. I have known three thousand five hundred bushels grown on sixty-nine and a half acres, and the grain weighed sixty-six pounds per bushel."

And again, from the Oregon Statesman, October 21, 1869:

"There are on Howell Prairie, in Marion County, six men living close together, who this year harvested an aggregate of three hundred and fifteen acres of wheat, yielding ten thousand eight hundred and forty-six bushels, or nearly thirty-four and a half bushels per acre. This has been a poor wheat season, and Howell Prairie is no better than the rest of Marion County. One of the same men, A. B. Simmons, selected six acres from his forty of oats, and measured up from the six acres six hundred bushels."

In the Willamette Valley the cultivation of flax is beginning to engage the attention of farmers to a considerable extent. The seed used is the Bombay variety, yielding a large crop of seed, but producing a fiber of inferior quality, and small in quantity. The upland ridges have been found best adapted to it. The yield ranges from twenty-five to thirty bushels per acre. The California Oil Mills have contracted, this year, for the product of six thousand acres in Linn County, the seed to be delivered at Albany at 2¼ cents per pound; and the Pioneer Oil Mills, at Salem, in this State, have contracted for the product of three thousand acres, at the same figures, delivered at their mills.

Fruit of nearly every description is raised with unusual success. The trees come into full bearing in three years from transplanting, and with very little care or cultivation yield heavy crops of fruit of the finest quality. Apples, pears, plums, quinces, cherries, currants, and all descriptions of small fruits and berries have a special adaptation to the moist climate and sea air of Western Oregon. Peaches, apricots, grapes, and that class of fruits, requiring a hot, dry climate, do not succeed so well in the northern part of the Willamette Valley and along the coast; but in Rogue River Valley and the hilly country west of it, where the climate is hotter and drier, more nearly approaching that of California, that class of fruits is cultivated very successfully. Thus far fruit trees in Oregon have been entirely exempt from the diseases incident to their cultivation in the majority of the older States.

Among the grasses, timothy, blue-grass, and clover are the kinds mostly cultivated; the former to a large extent as a hay crop. On the swales and ash bottoms it yields two to three tons per acre, very often without any cultivation, except to sow the seed after the ground has been cleared of brush, and burnt over. The abundant growth of wild grass renders unnecessary any extensive cultivation of grass for pasturing purposes.

Garden vegetables of all kinds and the various root crops are cultivated very successfully in all parts, particularly so on the timber lands and creek bottoms, where the yield of these products is very large. Except in a few instances for gardening purposes, irrigation of the soil is not practiced in Western Oregon. The abundant rains of spring and early summer, together with the fertility of the soil, render it entirely unnecessary.

Eastern Oregon consists of high table lands and rolling prairies, with a number of valleys along its water-courses, of considerable extent. Taken as a whole, it is especially adapted to grazing purposes, although its valleys contain farming lands equal in productiveness to those of any country; and in many places the high prairies have produced excellent crops of grain. North of the Blue Mountains, or what is known as the Great Plain of the Columbia, the soil of the highlands is a sandy loam, producing in its natural state a heavy growth of wild bunch grass of the most nutritious quality. In the central and southern portions of this division of the State, the highlands are

rugged and broken, the surface of the country, sometimes for miles in extent, being covered with broken trap rock; still, with the exception of a few barren spots, the growth of bunch-grass is undiminished, either in quantity or quality. It springs up fresh and green, in the first warm days of early spring, and in a few weeks stock be gin to fatten on it. By burning over the ground a fall growth is produced, which by the middle of October makes good grazing, and lasts through the short winter of that section of the country. It was the custom of the Indians of Oregon in former years to raise large herds of horses without providing any feed for them for the winter. The settlers and stock-raisers there now raise and fatten every year thousands of cattle, grazing them the year round. Fat beef cattle wintered and fattened on the "range" have been shipped down the Columbia, and thence to Victoria, on Vancouver's Island, to market, as early in the spring as the middle of March.

The valleys of Eastern Oregon have a rich soil of black loam, producing wheat, oats, barley, corn, vegetables, and fruits. Wheat succeeds equally as well as in Western Oregon, while barley does much better, often yielding as high as sixty to eighty bushels per acre. Corn makes a good crop in many of the valleys, the warm, dry summer weather of this region being adapted to its growth and maturity. Some of the tender fruits and vegetables, as peaches, grapes, melons, tomatoes, and sweet potatoes, are being cultivated with good success. Tobacco has succeeded well in several instances. In a general sense, the range of farm products varies very little from that of Western Oregon, making due allowance for the different adaptabilities of a dry climate. Irrigation is resorted to occasionally for the better production of garden vegetables and fruits; but thus far it has not been found necessary in the cultivation of any kind of grain crops. This part of Oregon has been settled but a few years, and experience has not demonstrated conclusively whether there is any liability of the failure of crops from drought or other causes, although the success attending farming operations thus far would indicate that no dangers of that nature are to be apprehended. It is claimed by the people of Eastern Oregon, that for productiveness its valleys cannot be excelled on the Pacific slope. The absence of timber in the valleys is considered a disadvantage by some; this, however, is more apparent than otherwise, from the fact that the neighboring mountains afford an inexhaustible supply. Water of good quality is plentiful in all the valleys, but the number of springs and running brooks is much less than in Western Oregon.

CLIMATE.

To give an account of the climate of any one county in the State of Ohio, would be to describe the climate of the entire State, in the main. Not so with Oregon, where the extent of territory is so great, that the various influences of mountain ranges, extended plains, contiguity to the sea, the prevailing winds, and other causes, operate to make a climate as varied as are the peculiarities of its numerous localities. Latitude on the northwest coast of America is no index to the character of the climate. Astoria, at the mouth of the Columbia River, situated on the same degree of latitude, nearly, with Quebec, has a summer temperature 8° cooler, and a winter temperature 30° warmer than that place. It is only in the high altitudes of the mountain ranges that deep snows and harsh winters have any existence in Oregon.

The following table, compiled chiefly from the reports of the Smithsonian Institution, will give a comparative view of the temperature of the four seasons, at several prominent points on the North Pacific slope, with that of a number of places east of the Rocky Mountains. The only point in Eastern Oregon embraced in the table is the Dalles, at the eastern base of the Cascade Range; a place influenced to a great extent by local causes, and does not fairly represent the climate in the extensive valleys farther east, constituting the principal agricultural and grazing districts of Eastern Oregon.

Table showing comparative mean temperature.

Localities.	Latitude.	Spring.	Summer.	Fall.	Winter.	Average.
Astoria, Oregon	46. 10	51. 16	61. 36	53. 55	42. 43	52. 13
Corvallis, Oregon	44. 30	52. 19	67. 13	53. 41	39. 27	53. 00
The Dalles, Oregon	45. 40	53. 00	70. 36	52. 21	35. 59	52. 79
Steilacoom, Washington Territory	47. 10	49. 00	62. 00	51. 00	39. 00	50. 00
Augusta, Illinois	40. 10	51. 34	72. 51	53. 38	29. 80	51. 76
Hazlewood, Minnesota	44. 20	42. 33	69. 95	42. 60	13. 06	41. 97
Albany, New York	42. 35	47. 61	70. 17	50. 01	25. 83	48. 41
Quebec, Canada East	46. 50	40. 00	69. 00	45. 00	12. 00	41. 00
New York City	40. 45	48. 00	72. 00	54. 00	31. 00	51. 00
Norfolk, Virginia	36. 50	56. 00	76. 00	61. 00	40. 00	59. 00

It will be seen from the foregoing that Corvallis, situated in latitude 44.30, and in the heart of Willamette Valley, has a winter temperature nearly the same as Norfolk, situated nearly 8° farther south, while the summer temperature of the latter place is nearly 9° higher than that of the former. It is this comparative evenness of temperature throughout the year that gives to the climate of Oregon its greatest charm.

The first thing that impresses a stranger in passing from Western into Eastern Oregon, is the very decided change noticeable everywhere in the atmosphere, vegetation, and general aspect of the country. This is due chiefly to the difference in the climate of the two sections: Western Oregon has a wet climate, while the Eastern part has a dry one.

The winter of Eastern Oregon, though of short duration, generally brings with it several inches of snow on the table lands and in the valleys. The weather is usually dry but quite cold. Snow remains from three to six weeks, in the months of December and January, some seasons; in others, only a few days. It is usual for stock to be grazed through these months without interruption, but occasionally there is a "hard winter," rendering it necessary to do some feeding. The spring begins in February and lasts to the end of May, with warm, pleasant weather, and rain sufficient to give life and vigor to vegetation. The summers are hot and dry, but not sultry or oppressive. It is very seldom that rain falls in summer or early fall; still the freshness of the mountain air renders the days pleasant and the nights cool and refreshing. The range of the thermometer is rather above the summer temperature of Western Oregon; sometimes reaching 100°, but only at rare intervals. Ordinarily the thermometer indicates 90° as about the highest summer temperature, and 10° as the lowest for winter, although these limits may not mark the extremes in the case of an uncommonly hard winter, or warm summer, occurring once in from five to eight years.

The amount of rain-fall in Western Oregon is regarded by some as an objection to the climate. The rain-fall, though large, has been generally overrated. To correct a false impression of the prevalence of rainy weather in Oregon the following recapitulation of a record of eleven years is given, as published in the Oregonian, showing that nearly two-thirds of the total number of days were "pleasant," or without rain or snow, between sunrise and sunset:

Years.	Pleasant.	Rainy.	Showery.	Snowing.
1858 (nine months)	180	48	43	4
1859	228	73	47	17
1860	232	72	57	5
1861	224	70	61	10
1862	250	47	52	16
1863	220	82	55	8
1864	252	60	47	7
1865	227	65	63	10
1866	230	73	59	3
1867	244	65	49	7
1868	272	30	55	9
Total	2,559	683	588	96

These observations were taken at Portland, where there is about as much rain as at any place in Oregon. The upper part of the Willamette Valley has considerably less; Umpqua Valley still less; and Rogue River less than either, the climate becoming dryer going south from the Columbia River, so that in the southern part of the State it approaches that of California.

The following figures show the rain-fall in inches for each season and for the whole year at New York, St. Louis, and San Francisco, as compared with Astoria:

	Spring.	Summer.	Fall.	Winter.	Year.
Astoria	16	4	17	22	59
San Francisco	8	0	2	11	21
New York	11	11	9	10	41
St. Louis	12	14	8	6	40

In a strict sense of the term, Western Oregon has but two seasons, the wet and dry. An ordinary rainy season begins early in November and continues to the 1st of April,

usually, with intermissions of good weather in January and February of a few days or a few weeks' duration. These intervals are generally accompanied by a few inches of snow, raw, cold weather, and sharp frosts, constituting the only approach to actual winter to which the country is subject. Stock in all sheltered localities get along through these cold snaps without feed, especially when pasture has been reserved for such emergencies. It is safe to assert that two-thirds of the stock of the valleys go through all ordinary winters by taking care of themselves in the pastures and woods; while along the coast, where tide and marsh lands are accessible, owners of stock do not pretend to feed. Once in seven or eight years there comes what is called a "hard winter;" that is, the winter interval continues six weeks or two months; snow remains on the ground several weeks; the cold weather is prolonged until the water-courses freeze. At such times stock will suffer unless it receives some attention. To offset the "hard winter" there occurs sometimes a very mild one, like the season of 1868-'69, with not even snow enough to whiten the ground, or cold to form ice thicker than window glass. Gardening operations were commenced in February that season, and flowers bloomed in the open air throughout the winter. There have been a number of such seasons in Oregon within fifteen or twenty years.

From April to the end of June the weather is usually warm, pleasant, and showery. The dry season proper commences about the 1st of July and continues to the end of October, interrupted by a week's rainy weather in September. The term "dry season," as applied to Oregon, does not imply excessive heat and sultriness, for such is not the case. The prevailing wind is from the northwest, a sea breeze that keeps the temperature down. The nights are cool and refreshing to men who do outdoor work, although the effect is not beneficial so far as corn-raising is concerned. The extremes of heat and cold in Western Oregon may be put at 14° for the lowest and 82° as the highest range of the thermometer, although a few instances have occurred in which these limits were passed.

A noticeable feature of Western Oregon, due mainly to the climate, is the excessive luxuriance of all kinds of vegetation, especially on the Columbia and along the coast. The country wears an appearance of perpetual spring. An Oregon fir tree often reaches an altitude of three hundred feet, or over eighteen rods; trees out of which have been taken eighteen rail-cuts, and many of which will make from six to ten thousand feet of lumber. The common elder becomes in this moist climate a tree of ten or twelve inches in diameter, and the alder grows large enough for saw-logs.

Another noticeable feature is that, although a rainy country, Oregon is not subject to high tempests, terrific hailstorms, earthquakes, or other like phenomena, so common and so destructive in some States. Observations made by government officers show that in twenty-one years Oregon had only three winds moving at the rate of forty-five miles an hour, with a force of ten pounds to the square foot. In Massachusetts, Rhode Island, and Connecticut the reports from eleven stations where observations were made show that in thirty months there were four winds of forty-five miles' velocity and ten pounds' power, and two winds of sixty miles' velocity and eighteen pounds' power. At eleven stations in Indiana, Illinois, Michigan, Iowa, and Wisconsin the reports show that during twenty-six months there were twenty-five winds of forty-five miles' velocity, two winds of seventy-five miles' velocity, and two hurricanes of a velocity of ninety miles an hour.

From a register of meteorological observations, kept at the Portland library rooms, the following record of the weather is compiled for the months of January and February, 1870:

January.—Highest temperature, 63°; lowest temperature, 17°; highest average for one day, 57°; lowest average for one day, 23°; mean temperature for the month, 40°; rain-fall for the month, 4.83 inches; snow-fall for the month, ½ inch.

February.—Highest temperature, 58°; lowest temperature, 32°; highest average for one day, 49°; lowest average for one day, 36°; average for the month, 42½°; total rain-fall, 4.30 inches; snow-fall, none.

These observations are useful as indicating the range of the thermometer at a season of the year when sudden changes are most likely to occur.

Observations carefully kept by Dr. I. Moses, United States Army, at Astoria, for a period of fourteen months, commencing August, 1850, and terminating September, 1851, show that during that period the greatest variation of the thermometer during any one month was 37°. The highest points reached by the mercury during the period was 94°; the lowest, 22°. The highest daily mean, 82°; the lowest, 26°. Variation during the coldest day, 6°; during the warmest day, 12°. Mean annual temperature, 53°. The Doctor remarks that, "these observations may be considered the average of the temperature, year after year, at that place, and when it is considered that Astoria is in about the same latitude as Houlton, Maine, and Sault Ste. Marie, the uniformity and mildness of the climate seem remarkable."

HEALTHFULNESS OF THE CLIMATE.

The experience of the early missionaries, the employés of the Hudson's Bay Company,

and the American settlers that followed them, during the course of a period of thirty years, is that the climate of Oregon is a healthy one. In comparing the rates of mortality in the Pacific States with that of some of the States east of the Rocky Mountains, the following facts are obtained: The deaths in Arkansas, in 1860, were at the rate of one person out of every 48; Massachusetts and Louisiana lost one in 57; Illinois and Indiana, one in 87; Kansas, one in 68; Vermont, the healthiest State on the Atlantic slope, lost one in 92; California lost one in 101; Oregon, one in 172; and Washington Territory, one in 228.

On this subject an article written by Dr. William H. Watkins, of Portland, a physician of seventeen years' practice in different parts of Oregon and Washington Territories, is introduced to illustrate whatever effect the climate may have on particular forms of disease as compared with that of several other States. The doctor writes: "Oregon, in truth, may be said to have no prevailing type of disease. In the Willamette Valley we have the soil, the alluvial deposit, the moisture, which, in Indiana or Illinois, would cause agues and intermittents to be rife through the community, and throughout the valley in spring and autumn occasional cases of ague are found, but they invariably yield to remedies in small doses compared with those given in malarial districts in the Western States. Very rarely is a person seen with the ague cachexia and complexion, so often seen in the ague districts of the Wabash, Illinois, and Sacramento Valleys. The type is commonly a tertian, or when a chill occurs every other day, though persons having a chill daily are met with.

"For this somewhat remarkabfe immunity from malarial disorders, considering the strength and depth of our river bottoms, we are indebted to our northern latitude, to the daily sea-breeze borne to us from the waters of the Pacific, to our cool, bracing nights, and to the medium temperature of even our warmest days. Typhus and typhoid fevers have never been epidemic in Oregon.

"The equable temperature, summer and winter, the absence of high cold winds and sudden atmospheric changes, render people less subject to bronchial, rheumatic, and inflammatory complaints than they are in countries where the thermometer swings entirely around the circle. In July and August, as at the East, children are troubled with summer complaint, but the disease is ordinarily quite amenable to treatment, and seldom runs into dysentery.

"East of the Cascades the air is dry, the altitude high, and the country is popularly supposed to be beneficial to consumptives. Army reports appear to sanction this belief.

"On the head-waters of the Columbia a disease somewhat peculiar, known as mountain fever, attacks the inhabitants if particularly exposed. It probably is malarial in its origin, but is modified by the variety and dryness of the atmosphere. It presents many features of remittent fever, is disposed to take a typhoid type with congestions of brain, lungs, and bowels. While at Fort Walla-Walla I attended twenty-two cases, soldiers who had made a summer and fall campaign up the waters of Snake River, all of whom recovered.

"For twenty years, aside from scarlet fever and diphtheria, which several years ago visited nearly every neighborhood, there has been no general epidemic of at all fatal character in Oregon. The general salubrity of the climate and healthfulness of the people cannot be questioned.

"I append some statistics of mortality, taken from the report of the Surgeon General of the Army, from several sections of the country:

"*Deaths from fever.*—New England, 1 in 283; harbor of New York, 1 in 66; the great lakes, 1 in 159; Jefferson barracks and St. Louis arsenal, 1 in 113; Texas, southern frontier, 1 in 67; Texas, western frontier, 1 in 529; Oregon and Washington Territories, 1 in 529."

POLITICAL SUBDIVISIONS.

Oregon is divided into twenty-two counties, viz: Baker, Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Grant, Jackson, Josephine, Linn, Lane, Marion, Multnomah, Polk, Tillamook, Union, Umatilla, Wasco, Washington, and Yam Hill.

Baker County is situated east of the Cascade Mountains, and presents a good field for settlement. During the past year a marked increase has been noticed both in the population and wealth of this county. Auburn, the county seat, is located about three hundred and fifty miles from Portland by the usually traveled route. Baker City, an important trading point, is located about ten miles south-east of Auburn, in the Powder River Valley. Taxable property of the county, $418,490. This county embraces one of the largest mining districts in the State.

Benton County, situated in the heart of Willamette Valley, contains a population of 4,669, with an assessable property valued at $1,133,097. Corvallis, the county seat, is one of the handsomest towns in the State, and is a place of considerable trade. It contains several excellent schools; a college conducted by the Methodist Church South; a female academy under the auspices of the Episcopalians; three churches—Methodist, Presbyterian, and Catholic. The Corvallis Gazette, a weekly newspaper, is published here. Assessed valuation of property in Corvallis for 1869, $374,347 79.

Clatsop County contains a population of about 1,200; voters, 250; acres of land under cultivation, 3,000; value of assessable property, $325,000. Astoria, the county seat, is pleasantly located on the left bank of the Columbia River, about ten miles above its mouth, and about one hundred miles northwest of Portland. During the past year many additional buildings have been erected, and when the custom-house now in contemplation has been completed, Astoria will present quite a city-like appearance. Astoria derives its name from John Jacob Astor, whose employés founded a fur depot at this point on the 12th of April, 1811.

Clackamas County combines within its limits all the elements that when properly developed tend to make a country prosperous. Immense water power exists along its river bank; the Oswego iron works, with its unlimited supply of ore, skirt it on the north, while its agricultural lands are extensive as well as excellent. Oregon City, the county seat, was formerly the seat of the territorial legislature, and is the oldest incorporated town in Oregon. All the merchandise and produce passing up and down the Willamette Valley goes through Oregon City, and each year witnesses a marked improvement in its prospects. Its present population is about 1,300. A flourishing graded school is in operation, with an attendance of nearly 200 scholars. The population of Clackamas County is estimated at 6,000; voters, 1,250; value of assessable property $1,532,924. Oregon City is the seat of the United States land office.

Columbia County is situated on the Columbia River, the boundary between Oregon and Washington Territory. This county contains a population of about 500. Number of voters, 220; acres of land under cultivation, 1,000; value of assessable property, $167,245. St. Helen, the county seat, is pleasantly located on the bank of Columbia River, and promises to be a place of much commercial importance. Lumber is extensively manufactured at this point, and during the past year the growth of the town has received quite an impetus. This county contains nearly 300,000 acres of unimproved land, some extensive but undeveloped mines of coal and iron, and valuable salt springs.

Coos County, situated in the southwestern part of the State, on the coast, contains a population of about 1,200, with assessable property valued at $432,273; number of voters, 500. Gold, copper, iron, and coal have been found to exist in this county, and the coal mines have already proved a source of great wealth. Lumber is manufactured extensively at North Bend, situate about ten miles from Empire City, the county seat. Ship-building is also carried on in this county.

Curry County, the most southwesterly portion of the State, contains a smaller population than any other county in Oregon. This may be accounted for from the fact that it is remote from the tide of immigration which annually flows into the State. Indications of copper ore have been found within its borders, and gold mines have been discovered and worked at Port Orford, on the coast. Ellensburg, the county seat, is situate on the southern bank of Rogue River. Taxable property of the county, $110,494.

Douglas County contains an area of about five thousand square miles. About 25,000 acres of land are under cultivation. The population numbers about 9,000; value of assessable property, $1,474,704; number of voters, 1,400. No county in the State presents a greater diversity of scenery than does Douglas. Roseburg, the county seat, is a thriving town of about 500 inhabitants. It is conveniently located on the direct stage route from Portland to Sacramento, and contains Episcopal and Methodist churches, schools, and a court-house. A United States land office is located here. This county embraces the entire Umpqua Valley, and is one of the best stock counties in the State. It contained, in 1869, 11,000 head of cattle, 160,000 sheep, and produced 430,000 pounds of wool. The county expended, the same year, $4,294 on roads and bridges, and paid its school-teachers $2,474 in currency and $3,044 in coin.

Grant County, situated in Eastern Oregon, contains a population of about 3,000; number of voters, 750. This county contains large tracts of excellent grazing lands, and numerous sections of agricultural soil. Gold mines have been discovered within its borders, and good paying diggings are being worked very extensively. Cañon City, the county seat, is a mining town of considerable importance. It is situated on the middle fork of John Day's River, and is distant from Portland about three hundred and fourteen miles. The county has about 3,000 acres of land under cultivation; taxable property, $321,604. Its estimated yield of gold since the discovery of the mines in 1861 is $10,000,000.

Jackson County covers an area of about eight thousand square miles, with a population of 6,000; number of voters, 1,300. This county combines within its limits agricultural, manufacturing, and mineral resources which will tend to render it in future of great importance to the balance of the State. For nearly eighteen years the gold mines of this county have been successfully worked, and even now they yield sufficient to repay for the outlay of capital and labor expended in working them. Jacksonville, the county seat, is a prosperous place, containing within its corporate limits many handsome buildings. The Methodists, Catholics, and other denominations have churches here, with several public and private schools. This county embraces the whole of

Rogue River Valley. It has about fifteen thousand acres of land under cultivation. Taxable property, $1,023,814. A fine woolen mill is in operation at Ashland.

Josephine County covers an area of two thousand five hundred square miles, with but 4,000 acres under cultivation. The principal source of the wealth of this county arises from its gold mines, which are annually being developed. Large tracts of good arable land are yet unoccupied in this county, and offer good homes to industrious settlers. Kirbyville, the county seat, is situated on the Illinois River, which flows through the Illinois valley, and is a lively town of growing importance. Taxable property, $212,553; number of voters, 350.

Linn County, one of the best agricultural districts in Oregon, covers an area of 1,400,000 acres; population, 8,000; number of voters, 2,308; value of assessable property, $2,960,694; acres of land under cultivation, about one hundred thousand. Albany, the county seat, is situated on the east bank of Willamette River, about seventy-five miles south of Portland. It is pleasantly located, and each recurring year adds to its population, wealth, and importance. The town comprises several brick stores, a large number of frame buildings, a court-house which cost upward of thirty thousand dollars, two flouring mills, four churches, a college, public schools, and all the other accessories of civilization. Two weekly papers are published at Albany. Harrisburg and Peoria are each prominent shipping points on the Willamette River in this county.

Lane County covers an area of about three thousand five hundred square miles, and embraces within its limits some of the finest agricultural lands in Oregon. About 60,000 acres of land are under cultivation in this county, and the value of taxable property is assessed at $1,769,780. Eugene City, the county seat, contains a population of about two thousand. It is situated at the head of steamboat navigation on the Willamette River, and contains an industrious and enterprising people. Among the public institutions of Eugene City are a commodious court-house, an academy, and several public and private schools. The Catholics, Presbyterians, Episcopalians, Baptists, and Methodists have each a church here. The office of the United States surveyor general is at this place. The county extends from the summit of the Cascades to the coast, and covers the southern part of the Willamette Valley. It has a population of about 8,000; number of voters, 1,400.

Marion County covers an area of nearly three thousand square miles. Its central position, excellent soil, and commercial advantages render Marion County one of the most prosperous portions of Oregon. Salem, the capital of the State and the county seat, is delightfully located on the east bank of the Willamette River, presenting a handsomer appearance than any other town in Oregon. This county has a population of 10,500; voters, 2,500; value of assessable property, $3,174,919. Salem can boast of more church edifices than any town of its size on the Pacific coast. The religious organizations represented by churches are the Methodists, whose first building was erected in 1841; Congregationalists, organized in 1853; Baptists, organized in 1859; the Catholic, Episcopalian, Campbellite, Evangelical Association, and Methodist Church South, organized more recently. The Oregon Statesman, Willamette Farmer, and Democratic Press are published at Salem. The Willamette University, the most prominent educational institution in the State, is located here. Salem is the seat of considerable manufacturing enterprise, having a woolen mill, an oil mill, several large flouring and saw mills, and an iron foundry in successful operation. The assessed value of town property for 1869 is $1,394,158; population, 3,500.

Multnomah County, although the smallest in size, is the wealthiest county in the State. Population, about 11,000; number of voters, 2,500; value of taxable property, $5,944,766. This county is situated in the extreme northern part of the Willamette Valley. It is bounded by the Columbia River on the north, and embraces within its limits the triangle formed by the junction of the Willamette with the Columbia River. The city of Portland, situated in latitude 45° 30′ north and longitude 122° 27′ west, the county seat of Multnomah County and the commercial capital of Oregon, is also the depot whence the people of a region of country larger than New England and the Middle States combined derive their supplies, including Eastern Oregon and a large portion of the Territories of Idaho, Washington, and Montana. The city is pleasantly located on the west bank of the Willamette River, twelve miles above its junction with the Columbia and one hundred and ten miles from the sea by the course of the river. It is located on a plateau, which gradually ascends as it recedes from the river until it forms a range of hills at the western extremity of the city, from which may be seen the summits of several mountain peaks in the Cascade Range, clothed in perpetual snow.

Commercially speaking, Portland is the key to the entire Willamette and Columbia River valleys, being the entrepôt at which arrive all the merchandise, goods, and wares of every description consumed or required by the people of the vast territory drained by the Columbia and its tributaries. With convenient wharves and warehouses for reshipping and packing, trade radiates in every direction to supply the extensive mining, agricultural, and lumbering districts of the State and surrounding Territories.

The Willamette River is navigable to Portland, at all seasons, for sea-going vessels. A line of first-class ocean steamships runs regularly between Portland and San Fran-

cisco, making three trips per month, and another line communicates regularly with Victoria, on Vancouver Island, and the different towns on Puget Sound. Portland, by means of sailing vessels, enjoys direct trade with New York, Liverpool, the Sandwich Islands, and China, affording advantages for the importation of foreign merchandise and for the exportation to distant markets of Oregon produce.

Portland has a population of about ten thousand inhabitants. Water is supplied to all parts of the town, by means of extensive waterworks, at low cost and of the best quality. The streets and public buildings, churches, &c., are lighted with gas. The city has five public schools and eight select schools and seminaries. It has sixteen churches, three Masonic associations, four Odd-Fellows' associations, three lodges of the Good Templars, six benevolent associations, and a library of four thousand volumes. Portland is the headquarters of the military department of the Columbia with its various staff departments, and the United States circuit and district courts for the districts of Oregon are held here. During the year 1869 treasure was shipped from Portland to San Francisco to the amount of $2,978,657 30.

Polk County covers an area of about one thousand two hundred and fifty square miles. Population, 5,000; number of voters, 1,270; taxable property, $1,518,511. The county has about one hundred thousand acres of land under cultivation. It is situated near the center of the Willamette Valley, and is one of the best counties of the State. Dallas, the county seat, is situated on the Rickreal, a small tributary of the Willamette, and is a flourishing inland town.

Tillamook County, situated on the coast, covers an area of more than two thousand square miles, but is very sparsely settled. Population, 500; acres of land under cultivation, 1,500; value of assessable property, $59,273; county seat, Lincoln.

Umatilla County, in Eastern Oregon, contains a population of about 2,500; number of voters, 850; acres of land under cultivation, about 20,000. Umatilla, the county seat, is a place of considerable trade, being the shipping point on the Columbia River from whence supplies are carried inland to the mining regions in Eastern Oregon and Idaho. The county has an area of about six thousand square miles, two-thirds of it arable land. Taxable property, $790,109.

Union County is situated in Eastern Oregon, and contains within its boundaries large tracts of excellent agricultural and grazing land. Population, about 4,000; number of voters, 1,000. La Grande, the county seat, is situated in the valley of the Grande Ronde, a most fertile region, about three hundred miles from Portland. The town contains about eight hundred inhabitants, a high school, and United States land office. It is located on the main route of travel from the Columbia River to Idaho and Utah. This county includes the whole of Grande Ronde Valley, containing 288,000 acres of arable land—15,000 acres under cultivation. Assessable property, $768,169.

Wasco County is situated at the eastern base of the Cascade Range. Population, about 3,000; number of voters, 609; assessable property, $905,704. Dalles City, the county seat, distant one hundred and fifteen miles from Portland, is a place of considerable trade, all the merchandise intended for Eastern Oregon having to pass through it en route to its destination. A woolen mill has been put in operation at this point, which will add materially to its progress. The Mountaineer, a well-conducted weekly newspaper, is published at the Dalles. The United States government is building a mint at this place. Wasco is one of the best stock-raising counties in Oregon.

Washington County contains a population of about 4,500. Number of voters, 803. Acres of land under cultivation, 25,000. Value of assessable property, $867,265. This county embraces some of the finest agricultural land in the State, and is well settled by thrifty farmers, whose industry is amply rewarded. 'Hillsboro', the county seat, eighteen miles west of Portland, is located upon the Tualatin plains, near a branch of the Tualatin River. This county has an area of 350,000 acres, nearly all arable land. The Pacific University is located at Forest Grove in this county.

Yam Hill County may be classed among the best agricultural portions of the State. It contains a population of 6,000. Number of voters, 1,208. Acres of land under cultivation, 60,000. Value of assessable property, $928,825. Lafayette, the county seat, is located on the left bank of the Yam Hill River, thirty miles southwest of Portland. It is annually increasing in business and population. The other towns and post offices are Amity, Muddy, Mountain House, McMinnville, North Yam Hill, Sheridan, West Chehalim, and Wheatland. This county raised 600,000 bushels of grain in 1869. The Yam Hill River is navigable to McMinnville during high water. The county contains about five hundred square miles, nearly all arable land.

MARKET FACILITIES AND COST OF TRANSPORTATION.

The Columbia River forms the northern boundary of Oregon, and is navigable to the Willamette, one hundred miles from the sea, at all seasons of the year, for sea-going vessels. Above the Willamette it is navigable by regularly established lines of river steamers to Wallula, a distance of two hundred and forty miles, with two interruptions, one of six miles at the Cascades, and one of fourteen miles at the Dalles, where portages are made by means of railroads forming connections with the boats. Above

Wallula the Columbia and one of its tributaries, the Snake River, is navigated to Lewiston during periods of high water, a point in Idaho Territory at the base of the Bitter Root Mountains, and over four hundred miles from the ocean.

The Willamette River is navigable to Portland, twelve miles from its mouth, for ocean steamers and sea-going vessels; and above Portland for river steamers as high as Harrisburg at all seasons, and during high water as high as Eugene City, a distance of two hundred miles from Portland, by the course of the river. The Yam Hill and Tualatin Rivers, tributaries to the Willamette, flowing from the west, are navigable during periods of high water to the interior of large agricultural districts situated in Yam Hill and Washington Counties.

The business of that part of Oregon drained by these waters employs about thirty river steamboats. All points of the Columbia from the Dalles down, and on the Willamette from Salem down, are in daily communication with Portland. San Francisco is the principal market for the products of the Willamette Valley, although a large trade exists with British Columbia and the lumbering districts of Puget Sound, and cargoes of wheat, flour, and other Oregon products are often shipped to the Sandwich Islands, China, Australia, South America, New York, and Liverpool, direct from Portland. Farmers, as a rule, dispose of their crops to the mills located in their own neighborhoods, or to dealers in Portland who ship to foreign markets on their own account.

The price of most farm products in the Williamette Valley is regulated by the condition of the foreign markets. Those markets, however, are numerous, embracing all the seaport towns in all the countries bordering the Pacific Ocean, so that notwithstanding wheat may be low in Liverpool, it might be high in China; or, if low in both these, it still may be high in South America. The outlet to the sea enjoyed by the region of country drained by the Columbia and its tributaries gives it an advantage in this respect over the sections in the interior of a continent.

The Umpqua Valley has less advantages in the way of markets for produce than the Williamette. Although the river is navigated for a short distance, and affords a means of access for goods and merchandise to supply the wants of the people, yet as a route of transportation for getting to market heavy crops it has thus far proved insufficient. Improvements, however, are being made in the river, and, with the expenditure of some capital in that way, the facilities for getting the crops of the Umpqua to sea will be very much improved. Rogue River Valley is situated still further from the seaboard than the Umpqua, and being entirely without navigable water of any kind its only market is among the mining population in that part of Oregon and northern California. The mines, however, furnish a good market as far as it goes. They have been sufficient to build up quite large and prosperous communities in the farming districts depending on them. Stock-raising has become the principal reliance of these two valleys in Southern Oregon. Stock dealers from California, Nevada, and Idaho visit them regularly every year, and buy up the surplus of all kinds, paying cash for it, thus giving the farmer a market at his own door for everything that can be driven away. His bacon and wool, of which the product is quite large, can be sent to market much easier than heavy grain crops, when transportation is expensive. Douglas County, in the year 1869, realized from the sale of its surplus live stock, bacon, and wool, $600,000 in gold. The people of Coos and other counties situated in the southwestern part of the State, on the coast, transact their business entirely with San Francisco. Coos Bay is the principal harbor; lumber and coal the principal exports. Farmers in this neighborhood have a home market for their produce, and, notwithstanding the richness of the soil and the large amount of farming land, the area under cultivation is so small that the coal mines and lumbering establishments import every year large quantities of flour to supply their wants.

In Eastern Oregon the farmers have a home market in their own mining camps and new settlements, and those of the Territories of Idaho and Montana. Consequently, prices rule higher than in Western Oregon, except in live stock, in which there is very little if any difference. The distance from the seaboard makes it somewhat expensive to market a crop in that direction; but, owing to the large number of persons employed in the mines, and the small number of farmers, there is very rarely a surplus of farm product. Live stock finds a market not only in the mining districts, but in the surrounding States and Territories and in British Columbia.

PRICE OF FARMING LANDS.

In Western Oregon farms are of large size, generally 640 acres, often twice that number; a natural result of the policy adopted by the general government toward the early settlers. The settlements of the Willamette Valley cover an area about equal to the State of Connecticut, but its population is only about 75,000 or 80,000. As a matter of course only a small proportion of the land is under cultivation. Land is cheap, because there is so much of it in proportion to population. To furnish the data from which an estimate may be made of the average price of farming lands, recourse is had

to the books of the Board of Immigration, and of a prominent firm of real estate agents in Portland.

On the books in the office of the Board of Immigration there are twenty-five farms offered for sale, at prices ranging as follows: One at $25 per acre; three at $20; one at $19 25; one at $14 25; one at $13; one at $12; two at $11 50; one at $10; two at $9 50; two at $9 25; three at $7 50; one at $6 66; two at $6; one at $5 75; two at $4 50; one at $3 50; average, $10 94.

The books of the real estate agents exhibit twenty farms for sale in Multnomah County at an average of $11 per acre, and twenty in Clackamas County, at an average of $8 per acre; highest price, $27 50; lowest $3. In Yam Hill County the same firm has ten farms for sale at an average price of $7 per acre; highest, $18; lowest, $4; and in Washington County they have forty-two farms, at an average rate of $7 50 per acre. The preceding figures represent the value of farming lands in the northern and central part of the Willamette Valley as nearly as it is possible to arrive at it. Unimproved timbered lands throughout the same region are held at from $1 25 to $4 per acre, except immediately around the city of Portland, and perhaps some other towns, where the rapid growth of the town and the increasing value of town property give a value to adjacent lands for homestead and other purposes, much higher than for mere farming purposes. The wide range in the prices of the foregoing list is to be attributed mainly to difference in improvements. Of course, costly improvements add very much to the rate per acre, while a farm with cheap and temporary improvements is offered at a price but little if any above the value of wild land. The distance from navigable water and facilities for marketing are also considerations that go to make up the value of a farm. No data are at hand from which to get an average of the price of land in other parts of Oregon, but it is confidently believed that nowhere will it exceed the prices embraced in the foregoing list, and in most places it will fall below it.

GOVERNMENT LANDS.

The large valleys of Western Oregon were settled at first under the donation law of 1850, which gave to each man of a family 640 acres of land, and to every single man 320 acres, in consideration of occupancy and cultivation for a period of years. This law expired in 1854, but was in force long enough for the finest lands in Western Oregon to be taken by settlers under its provisions. The pre-emption and homestead laws of the United States were afterward extended and applied to Oregon, which enabled subsequent settlers to obtain 160 acres each, so that the prairie lands of the three principal valleys are at the present time about all occupied. While such are the leading facts relative to the prairie lands of the valleys, there are still good government lands to be had among the foot-hills each side of the valleys and on the slopes of the mountain ranges. These slopes and valleys are more or less timbered, the uplands generally with fir, pine, and cedar, and the valleys and creek bottoms with a growth of ash, alder, maple, and underbrush. The quality of the lands, even on the high ridges, is superior to the average farming lands of New England, and on the bottoms it is equal to any land in the world. The amount of land of this description in Western Oregon still vacant and subject to be taken under the homestead and pre-emption laws is greater than that comprised within the whole State of Massachusetts. There are several localities near the coast where several hundred families could settle in a body, on lands of the best quality, in a section and climate adapted to the growth of all classes of farm products except corn.

In Eastern Oregon the amount of government land still vacant is very large. The section of country known as the Klamath Lake region, in the southwestern corner of Eastern Oregon, is as large as the State of Rhode Island. About half of it is the finest kind of arable prairie land, the remainder good grazing and timber lands, all well watered. This entire section of country does not now contain over forty or fifty settlers. In the northern part of Eastern Oregon is a strip of high, rolling prairie land, ten or fifteen miles wide, skirting the northern base of the Blue Mountains, and extending from the Cascade Mountains to the eastern line of the State, a distance of one hundred and fifty miles. It is reasonably well watered; timber convenient on the adjacent mountains, and well adapted to grain-growing, grazing, and dairying purposes. Its present number of settlers is very small. Vacant lands in large quantities are still to be obtained in Grande Ronde, John Day's, Harney Lake, and Deschutes Valleys, in addition to which there are hundreds of small valleys distributed throughout the vast territory known as Eastern Oregon, containing bottom land of the finest quality for farming, and hill and table land unsurpassed for stock-raising purposes.

The great majority of the vacant lands in Eastern Oregon still belongs to the government. The exceptions are, in the case of the State of Oregon, which has located several large tracts under acts of Congress, granting lands for certain specific purposes, and grants given to two different military road companies of alternate sections for three miles each side of their respective roads. The land inuring to the roads under these grants is private property, and will be sold at whatever it will bring; that

belonging to the State is for sale, under an act of the legislature, at $2 per acre, and the reserved sections of government lands within the limits of the wagon road grants are subject to homestead settlement at the rate of eighty acres to each settler. All other government lands can be taken at the rate of one-quarter section, or one hundred and sixty acres to each settler.

There are three land offices in Oregon for the transaction of business connected with the disposal of government lands: one at Oregon City, in the Willamette Valley; one at Roseburg, in the Umpqua Valley; and one at La Grande, in Grand Ronde Valley.

STOCK RAISING.

The facilities which exist in Oregon for raising stock have been mentioned heretofore in connection with the soil and climate. But in order to illustrate those facilities more clearly, reference is had to the statistics of the government contained in the census reports of 1860; and a comparison drawn between the cost of raising stock in Oregon, on the northwest coast, and in Maine, on the northeast coast of the United States, both States being situated in about the same latitude. Maine produced, in 1860, 975,716 tons of hay, feeding 890,148 head of stock, embracing horses, cattle, and sheep. Oregon, the same year, produced 26,441 tons of hay, feeding 267,025 head of stock. The average consumption of hay for each animal in Maine was 2,197 pounds, against 197 pounds consumed in Oregon. Estimating the hay to be worth $6 per ton, the cost of wintering an animal in Maine was $6 59; in Oregon, 59 cents, a difference of $6 per head. The animals in Maine were worth $15,437,533, or $17 34 each. The stock in Oregon was worth $6,272,892, or $23 49 each, a difference of $6 15 per head; to which add the difference of $6 for feed, and the result is $12 15 net value in favor of each head of stock owned in Oregon that year, over and above the net value of each head owned in Maine.

The difference would be greater even than this if the expense and labor of housing and feeding out the hay were taken into account; and when it is remembered that hay does not constitute the entire feed of stock in cold climates, but that grain, straw, rutabagas, &c., form an important item, the disadvantage under which Maine labors appears still worse. The discrepancy is not so great in the case of some of the States of the Mississippi Valley; but even there it is an undetermined question whether the cost of raising stock does not exceed its value when ready for market.

The following are the prices of live stock in the Willamette Valley, April 1, 1870, as near as can be ascertained: Saddle horses, $80 to $100; ordinary work horses, suitable for farm work, $100 to $125; stage horses, $100 to 150; draught horses, $150 to $200; good carriage horses, $200; team mules, $250 to $350 a pair; work cattle, per yoke, (an average,) $100; milch cows, $40 to $50 for good ones; two-year old heifers, $20 to $30; yearlings, $12 to $15; sheep, $1 50 to $2 50; beef cattle, per pound, net, 6½ to 7 cents; fat hogs, 7 cents; mutton sheep, $2 50 to $3 50 apiece. In other parts of the State prices do not vary materially from the foregoing, except that in and around the mining camps they are a little higher.

To give an idea of what is now being done in this branch of industry we append an extract from an article on the "Resources of Oregon," written by the editor of the Portland Evening Commercial, a gentleman thoroughly informed on the subject of which he writes:

"Much attention is given to the breeding of thoroughbred and good-blood stock in Oregon, horses, cattle, sheep and hogs, and in the eastern division of the State to the breeding of fine mules also. Noted sires and dams have been brought from Kentucky and other States to improve the already good native stock of horses, and from these have sprung splendid racers, fast trotters and roadsters, and carriage and draught and work horses of such quality as to command the highest prices in the horse markets of California and Nevada. Durham and other famous breeds of cattle have been brought from Illinois, New York, and New Jersey; also the best breeds of Spanish and French Merino, Cotswold, Southdown, and other celebrated or favorite sheep from Vermont, New York, England, and Australia, for wool and mutton both; and Chester White Essex, and Berkshire hogs are to be found throughout the State, imported direct from England or the East."

MINERAL RESOURCES.

The first gold mines were discovered in Oregon in 1850, in Jackson and Josephine Counties, in the southern part of the State. Some years afterward quite extensive placers were opened in Douglas County on the tributaries of the Umpqua River. All these yielded immense returns for the first few years, and afforded employment to a considerable proportion of the gold-hunting population that found its way to the Pacific coast in the early times of California. At the present time these placers, although skimmed over and stripped by the labors of more than half a generation of their surface wealth, still form no insignificant part of the natural resources of the State. Fully one-fourth of the population of those districts is engaged directly in the occupation of mining, and not less than three-fourths are dependent in some way, directly

or indirectly, on the annual yield of the placers for their success in business. The yield of gold from the mines of Southern Oregon for the past ten years cannot fall short of an average of one million dollars per annum. It is a cash market at home for the farm and dairy products of almost the entire southern part of Western Oregon. A season of uncommon depth of snow in the mountains, and consequently of high water in all the creeks and streams during spring and early summer, makes flush times, not only with miners themselves, who rely on the fall of snow or rain to fill their ditches and carry on their washings, but to the farmer, merchant, and mechanic, who supply the miner with the necessaries of life. Ten years ago it was said that these mines were exhausted, but they have yielded ten million dollars since then, and still hundreds of men find profitable employment in working them. New placers are found occasionally; old ones that had been carelessly skimmed in the feverish haste of the early mining days are being reopened, and often made to yield as well as at first by means of better appliances for saving the gold.

Gold mines were discovered in Grant and Baker Counties, in Eastern Oregon, in 1861, and have been worked continuously every year since then. Like the mines of Southern Oregon, they are mostly placers located on the bars, banks, and in the beds of streams, and depend on heavy snows in the mountains and an abundance of water for successful working. They furnish constant employment to something like two thousand men. Like the mines of Southern Oregon, they are said to be worked out; still they ship to San Francisco every year over a million dollars in gold dust.

There can be no doubt that the cream of the placer mines has been taken. Rich strikes, once common in all the mining districts, are now of very rare occurrence. Big fortunes are not made in a day in the mines any more than they are anywhere else; but still, laboring men find profitable employment in them. Industry and economy are all that are necessary in mining, as well as other avocations, to acquire substantial competence.

Coal mining is carried on at Coos Bay to a considerable extent. The principal vein at that point extends along a ridge bordering the bay, convenient of access for twelve or fifteen miles, and is being worked at present by two companies. The coal is a good quality of soft or bituminous coal, and finds ready sale in San Francisco. Vessels are constantly loading at the mines and departing for that market. The coal deposit has been worked about fifteen years, and promises to be inexhaustible. Coal of the same variety has been found in large quantities at several other points on the coast. At Port Orford and Yaquina Bay attempts on a small scale have been made at mining and marketing it, generally with indifferent success, for want of sufficient capital. Near St. Helens, on the Columbia River, an extensive bed of coal has been discovered, and a small amount of work done toward opening and developing it. Deposits have also been found in Clackamas, Clatsop, and Tillamook Counties, as well as in the adjoining counties of Washington Territory, all of which promise, from their extent, quality, and conveniences for shipping, to afford profitable employment for labor and capital at no distant day.

Extensive beds of iron ore exist at several points in the northwestern part of the State. At Oswego, six miles above Portland, on the banks of the Willamette River, the Oregon Iron Company has erected works for reducing the ore of an extensive deposit in that neighborhood. The works of this company, although of small capacity, have supplied the foundries of the State with pig iron for the past three years, and shipped considerable quantities to the San Francisco market besides. The iron is of very fine compact grain, superior for most kinds of work to the best Scotch pig.

Notwithstanding the value to the State of its gold placers, and the attractions they may have formed to previous immigrations, there can be no question now but that the future mineral wealth of Oregon is in its resources of coal and iron now hidden in the mountain ranges. Taken in connection with the great productiveness of the soil, the great quantity of timber on every hand, and other conditions that adapt the State to general manufacturing purposes, this vast supply of mineral wealth assumes a peculiar importance.

MANUFACTURING INTERESTS.

In the various branches of manufacturing industry Oregon has barely made a commencement, notwithstanding her great capacities in that line. The leading manufacturing establishments now in operation are six woolen mills, located as follows: One at Oregon City, one at Salem, one at Brownsville, one at Dallas, one at Ashland, and one at the Dalles; an oil mill at Salem; a paper mill at Clackamas, together with quite a large number of flouring mills. The Willamette woolen mills, located at Salem, the oldest and largest of that class of establishments, consume annually about 400,000 pounds of wool and employ in the neighborhood of one hundred hands regularly. The blankets, flannels, cassimeres, and other goods made by this and similar establishments in the State have been put on exhibition in eastern cities repeatedly, always eliciting the highest praise, and frequently taking premiums at the industrial fairs of other States. The cost of manufacturing these goods is low enough to cause them to

enter very largely into general use not only in Oregon but in Idaho, Montana, and Washington Territories, excluding to a great extent imported goods from these markets.

The Pioneer Oil Mill, at Salem, manufactured 60,000 gallons of linseed oil last year, and expects to turn out 100,000 gallons in 1870. It is in contemplation to establish a linen factory in connection with the oil mill, as farmers are turning their attention to flax growing. It may reasonably be expected that this branch of manufacturing industry will become an important one in a few years.

The Clackamas Paper Mills are confined to the manufacture of straw, manilla, hardware, and news paper. The mills have a capacity of two thousand pounds per diem with twenty-five hands. The ordinary running force is from twelve to fourteen hands, producing one thousand pounds of paper per day, of an excellent quality, which finds ready sale in a home market.

Among the large flouring mills of the State may be enumerated the Standard Mills, at Milwaukee, the Imperial Mills, at Oregon City, the Salem Mills, at Salem, and the Magnolia Mills, at Albany. These have a capacity of 300 to 500 barrels of flour every twenty-four hours. A great many others scattered throughout the farming districts of the State, of smaller capacity, supply the necessary facilities for converting into flour and marketing the wheat crops of their respective neighborhoods. The estimation in which Oregon flour is held in San Francisco may be inferred from the following extract taken from a late number of the Commercial Herald, of that city:

"The arrivals of flour and wheat from Oregon continue liberal, as will be found elsewhere detailed. The better brands of extra which reach us from our sister State enter largely into the local trade of the city. Many of our bakers, hotels, and large consumers give it a preference over all others, simply by reason of its strength, having more gluten, and therefore requiring more water in its preparation, making a larger loaf, and consequently esteemed more profitable."

Among the minor but equally important branches of mechanical and manufacturing industry are sash, door, and other wood-working shops, tanneries, distilleries, carding machines, foundries, and machine shops; all of these calculated merely to supply the local demands. The iron foundries and machine shops of Portland have excellent facilities for supplying the wants of the country with all articles in that line, but nothing is manufactured for export.

The resources of the State in timber, iron ore, and coal, together with the wonderful fertility of its soil and the great amount of water power, should make Oregon a great manufacturing State. The climate is adapted to wool-growing to a degree equal if not superior to that of any other State, yet fully one-half the wool crop goes to San Francisco to market every year, notwithstanding the manufacture of woolen goods has received more attention from the people than any other class of manufactures. The few small tanneries at work in different parts of the State do not near supply the country with leather. Large numbers of hides are shipped to San Francisco annually, and leather for the ordinary wants of the people imported, which by the introduction of labor and capital could be made at home; for the hemlock and other bark produced in enormous quantities in the Oregon mountains have no superior for tanning purposes. Almost all the agricultural implements in use are imported from New York, yet all the raw material is here in great abundance for their manufacture.

The growth of the country and the expansion of the agricultural interest from year to year increase the demand for nearly all manufactured articles; but, like all new countries in this respect, manufactures are of slow growth, and must wait for the necessary capital to be accumulated, or the introduction of it from other quarters.

LUMBERING RESOURCES.

It has already been stated that the mountain ranges of Oregon are heavily timbered. But that term, in the sense in which it would be used in nearly all the Eastern States, conveys no adequate idea of the immense forests which clothe the Cascade and Coast ranges of mountains. The principal lumbering establishments are located on the Columbia River, below the junction of the Willamette, and at various points on the coast, where inlets, bays, and arms of the sea provide safe anchorage for small craft, and where the forests are easy of access from navigable waters. In the interior of the State are many small mills erected for the purpose of supplying their own immediate neighborhoods, conducted solely with reference to that object.

The varieties of timber adapted to general lumbering purposes are the red, white, and yellow fir, cedar, spruce, hemlock, and in some parts of the interior pine and larch. The yellow fir is the main dependence for all purposes requiring strength and elasticity. It enters into general use for building, fencing, bridges, wharves, piles, spars, and ship timber. Cedar is used for finishing material, for posts, and in foundations where it will come in contact with the ground, on account of its durable qualities in such situations. An excellent quality of ash is obtained along the streams and on the low lands in Western Oregon, suitable for many different mechanical purposes; but there is no hickory or other timber suitable for wagon or carriage work. All that kind of timber

used is imported from the Atlantic seaboard, although oak of a fair quality can be procured in places. Maple and alder are abundant, and of good quality for cabinet work, for which they are used almost exclusively.

Lumber, like other Oregon products, finds its principal market at San Francisco and in the southern part of California. The agricultural portions of that State are destitute of timber. The cities and coast valleys, particularly, rely entirely on the saw-mills of Oregon and Washington Territory for building, fencing, wharf, bridge, and ship timber. In addition to San Francisco, a large market for Oregon lumber exists at the seaports of Mexico, South America, Sandwich Islands, China, Japan, and Australia. Cargoes of lumber have been shipped from the Columbia River to New York and Liverpool with profit. Considering the rapidly increasing demand for lumber and timber of all descriptions at all these places, it is safe to presume that the market for Oregon lumber will continue to be good; and considering the approaching scarcity of the article in what has been hitherto considered good timber countries, the great supply in the forests of Oregon and Washington Territory, together with the natural advantages for marketing commanded by lumbermen there, will put all thought of serious or dangerous competition out of the way.

Extensive lumbering establishments are now in operation at the following places on the coast of Oregon, commencing at the southern boundary of the State, and going north: Ellensburg, at the mouth of Rogue River; Port Orford, Randolph County, at the mouth of the Coquille; Coos Bay, the mouth of the Umpqua and Yaquina Bay. Coos Bay is the principal one of these points, partly on account of its lumber trade and partly on account of its coal. The two together have been the means of building up quite a considerable commerce, although the population is small. There are three large mills in operation there, having a joint capacity of 75,000 feet of miscellaneous lumber every ten hours when in ordinary running order. They are all driven by steam. The mill owners have their own vessels, specially constructed for the purpose of transporting their own lumber to market. About 20,000,000 feet are shipped from this place every year. Notwithstanding the drain upon the timber on the shores of the bay, carried on at this rate for the past ten or a dozen years, the supply is still large enough to offer inducements for the erection of other mills of larger capacity and power than any of those now at work.

At Portland there are three mills in operation, having a joint capacity of 45,000 feet in ten hours. Their business is confined to the manufacture of lumber for the local market. The machinery consists of the ordinary double circular, edgers, trimmers, lath saws, slab saws, and the necessary planing and other dressing machinery to meet the wants of the market for dressed lumber, all driven by steam power. Their logs cost $5, coin, per M., delivered in the boom at the mills. Labor costs them, in gold, $4 dollars per day for head sawyer, $5 for hands with the planing and dressing machinery, and from $2 to $3 for all other classes of labor. They receive for lumber the following rates, (April 1, 1870:) Street lumber, $11 to $12; miscellaneous rough lumber, $14 to $15; flooring, $26 to $28; siding, $20 to $21; miscellaneous lumber, dressed, from $20 to $31—all in gold. These rates include the delivery of the lumber to any part of the city. The three mills turned out the past year about 7,600,000 feet of lumber of all grades, all of which was consumed in the city.

On the Columbia River, below the junction of the Willamette, there are a number of small mills in operation. Two of the largest have a capacity of 15,000 feet per day each. The others average from 3,000 to 10,000 feet per day. One is now in the course of construction at the mouth of the river calculated to cut from 40,000 to 50,000 feet every ten hours. A small part of the lumber made on the lower Columbia is consumed at Portland; the bulk of it goes to San Francisco, China, South America, the Sandwich Islands, and Mexico. The expenses of running a sawmill on the Columbia are a little less than at Portland. Logs cost less by $1 or $1 50 per M., and the cost of labor is somewhat less, particularly unskilled labor. The mills are generally located on the bank of the river, or a navigable slough or tributary, for the convenience of shipping the lumber, as well as for getting the logs to the mills economically. The price of lumber at these mills is always determined by the San Francisco price, that being the principal market. Freight to San Francisco, by sailing vessels, is now $6 per M.; the San Francisco price for miscellaneous rough lumber is $16, leaving the lumberman $10 as the net price of his lumber at the mill. Lumber, like all other commodities, fluctuates more or less at the leading markets; the prices are now "down." From $20 to $22 is about the highest range in San Francisco for common lumber when the market is active and prices up.

The saw-mills of the Columbia, like those of other places in Oregon and Washington Territory, use the double circular, and the usual edging, trimming, and dressing machinery, driven in some cases by water and in others by steam power. Taken in the aggregate, they manufacture and send to market every year a large quantity of lumber of every grade. The sloping hill sides, descending to the banks of the river on both sides from the Willamette to the sea, a distance of a hundred miles, are clothed with a dense, compact growth to the water's edge, of all the varieties of timber common

to the northwest coast. Experienced lumbermen estimate that the timber within one mile of the navigable waters of the Columbia, suitable for saw-logs, cannot be exhausted by the saw-mill force now in operation during the present generation. A hundred thousand feet of lumber have been taken from an acre of ground, and it is not uncommon for six to eight thousand feet to be obtained from a single tree. The usual rate of stumpage is 50 cents per M. when logs are obtained in that way. Generally mill-owners buy the lands, and have the logs delivered by contract. The method adopted for getting the logs to the mills is to haul them to the water's edge on wheels from the place of cutting, generally not over a few hundred yards; then after getting them into the water they are made into rafts to be floated to the mill, if down stream, or towed by a small tug, if they are to go up stream. Timbered lands well situated for logging purposes are held at $8 to $15 per acre. Within three miles of the river government lands can be obtained in any quantity.

FISHERIES.

The salmon is the principal fish of Oregon waters. It is noted among the most delicious of its species in any part of the world, and it is so plentiful in its season that it has constituted the principal article of food for the Indian tribes of the country from time immemorial. It enters largely into general consumption as an article of diet with the present population during the spring and summer. The salmon fisheries of the Columbia River have become an important branch of Oregon industry. Until within the last few years they were worked almost exclusively by Indians and half-breeds, producing a few barrels of fish annually, to be exchanged for a few necessary supplies. Now they engage the attention of capital amounting to many thousands of dollars and the labor of several hundred men.

The heaviest business is done by the canning establishments, of which there are four, employing in the aggregate about two hundred men during the busy season, and from eight to ten each during the remainder of the year.

The process of canning salmon has been lately introduced. It consists in cooking and seasoning the fish for the table, after which it is put, while hot, into tin cans containing one or two pounds, and hermetically sealed. The cans are then packed in cases of two dozen two-pound or four dozen one-pound cans in a case for shipment. There is but little local demand for the article thus prepared, on account of the large supply and low price of fresh salmon. But it has been introduced into foreign markets with great success.

Export statistics show that San Francisco received from the Columbia River, during the year 1869, 22,130 cases of canned salmon. Two dozen cans to the case would amount to 531,120 cans, shipped to San Francisco alone. A considerable portion of this, however, was forwarded to New York City. The estimate of persons intimately acquainted with the business is that the product of canned salmon for the year 1869 would reach an aggregate of 800,000 cans.

The canning houses are provided with the necessary boats, nets, and other appliances for catching the fish, and generally rely on their own catch to supply the cannery, although the practice is obtaining of buying fish from others who carry on fishing on a small scale without sufficient capital to conduct the canning business. The price paid in such cases range from 20 to 30 cents each. The average weight of the Columbia River salmon is from 20 to 25 pounds.

Aside from the canneries about one hundred men are engaged in salmon fishing, generally in parties of from two to six, who have their own nets, boats, and tackle, and carry on business either to supply the Portland market with fresh fish, or salt and can their fish to be marketed in Portland, whence it is shipped to San Francisco or to the Sandwich Islands. During the year 1869 the shipments of salted salmon to San Francisco amounted to 3,792 barrels and 4,744 half barrels. The usual price of salted salmon at Portland is $9 to $10 per barrel.

The fishing season commences about the first of April and continues until the last of July. There is usually a fall run of salmon, but the fish are not so good as the spring run.

Sturgeon, tom-cod, flounder, and smelt are very plentiful in the Columbia, and mountain and brook trout in all the small streams throughout the country. The market is plentifully supplied with all these in the season.

Oyster fishing is carried on to some extent at Shoalwater Bay, in Washington Territory, and at Yaquina Bay in Oregon. At the first-named place about 100 men are employed in one way and another. At Yaquina Bay the number is not so large nor the facilities for culture so good. The oysters at both places are small but of fine flavor. They find a ready market at Portland and in the interior towns of Oregon, and at San Francisco.

SCHOOLS.

The school fund of this State is under the management of a board of commissioners, consisting of the governor, secretary of state, and State treasurer, who loan the fund

at the rate of ten per cent. per annum interest, secured by mortgage on real estate. This fund amounted in 1868 to $242,228, bringing an annual interest of $24,222, to be distributed by law to the several counties for common school purposes, the amount to which each county is entitled being determined by a census of its children of the lawful age to entitle them to the benefit of the fund.

Each county levies a tax yearly for common school purposes, and each school district is authorized by law to levy a tax, in addition, sufficient to make the schools free to all and to keep them open the entire year. This is the case in all the larger towns and most populous districts.

EMIGRANT ROUTES TO OREGON.

From all parts of the country on the Atlantic seaboard there are two practicable routes of travel to Oregon:

1st. By railway, across the continent. This is much the most expeditious route of the two, and for emigrants for any point in the Western States is preferable to the other. Through tickets to San Francisco can be purchased at all the large cities of the Atlantic States, making the connection with the main line of road at Chicago or Omaha. The usual time consumed in making the trip to San Francisco is about seven days from New York and six days from Chicago. From San Francisco to Portland, Oregon, the trip is made by ocean steamer in about four days; distance, six hundred and forty miles.

2d. From New York to San Francisco by ocean steamer, via Panama. The steamers of the Pacific Mail Steamship Company leave New York on the 5th and 21st of each month; time to San Francisco, twenty-two days. The fare by this route is somewhat subject to fluctuation, but always lower than the fare by railway. The rate is about $125 in the cabin and $65 in the steerage, both in currency. Passengers by this route are allowed a larger quantity of baggage free than by railway, and would not have to pay as high rates on extra baggage.

AGRICULTURAL CAPABILITIES OF THE TERRITORIES.

As civilization, with its rural industries, advances westward, the plains once assumed to be deserts yield rich rewards to judicious labor; the barren hills, subjected to irrigation, become verdant and fruitful; and the spy upon the nakedness of the land begins to wonder where are the western wastes, what are the spots of seeming barrenness that are really destined to remain forever unclad with verdure, and whether any portion of the Rocky Mountain domain is and must ever be absolutely worthless, after all the expedients of skill and energy are exhausted, the irrigating ditches, artesian wells, the planting of forest trees, the clothing of the surface with the verdure of growing crops, and the amelioration of good and thorough culture. It is difficult to set a limit to the capacity of the earth for production when subjected to the highest human intelligence and the most skillful practice of him who was appointed to till and to dress it. The following notes relative to the agricultural capabilities of the Territories are desultory, but an endeavor has been made for reliability and truthfulness, in opposition to the enthusiasm tending to extravagance so natural to the pioneer, who is a sort of discoverer of a new world of fruitfulness. The Department is extending its means of observation and accurate knowledge of this great region, and will continue to devote no small moiety of its attention to the capabilities and wants of the States and Territories of the Pacific Coast and Rocky Mountains.

COLORADO.

Colorado Territory is situated between 37° and 41° of north latitude, and 102° and 109° of west longitude, extending north and south about

two hundred and seventy-eight miles, and east and west about three hundred and seventy-six miles, and contains an area of one hundred and four thousand five hundred square miles, or 66,880,000 acres.

This magnificent region is divided by its physical features into three natural grand divisions. That portion west of the dividing range of the Rocky Mountains belongs to the basin of the Colorado of the West, and is but little known north of the Uncompahgre Mountains. Explorers have crossed it at different points, trappers and hunters have penetrated its defiles, and miners have prospected its hills and mountain sides; but it presents no civilized population, no mining or agricultural settlements of any extent. From the indications observed, the great mountain ranges subside more gradually on this side than on the eastern slope, where they sweep abruptly down upon the plains. The Grand, White, Green, Gunnison, and other tributaries of the Colorado rush down through deep gorges and rocky cañons, often so narrow and precipitous as to preclude access to the waters of these streams. Alternating with these are wide rich valleys, elevated plains, and small parks, mostly covered with sage brush or low shrubbery and grass.

South of the Uncompahgre Mountains the western part of Conejos County contains a few settlements, chiefly Mexicans.

The central or mountain division, from one hundred to one hundred and fifty miles wide, extends across the Territory from north to south. These mountains are composed of several ranges, nearly parallel in general direction, but curving backward and forward at every conceivable angle, often meeting each other and inclosing depressed areas. They vary in altitude from 8,000 to 17,000 feet above the level of the sea, the higher peaks being covered with perpetual snow.

The axis of upheaval constituting the main continental "divide" twists through the Territory in a serpentine course, inclosing within its convolutions minor divides of scarcely inferior altitude, separating the waters of great rivers. These chains often separate at a wide angle, giving scope to the peculiar feature of the topography of Colorado, its magnificent parks. These mountain basins vary in size from a few hundred acres to several thousand square miles. The largest, San Luis Park, South Park, Middle Park, and North Park, are situated in a line north and south along the central mountain belt, lying alternately on the east and the west side of the dividing crest.

The San Luis Park, the most southerly and largest of the series, is scarcely a true park, but a large elliptical valley surrounded by the separating ranges of the mountain chain. The average elevation of its surface is about 6,400 feet above the level of the sea. Although generally level, yet at points there are basaltic mounds, hills, and elevated mesas, and broad terraces elevated a few feet above the lowest level. Its extreme length in a direct line from Rio de Taos on the south to Poncho Pass on the north is about one hundred and fifty miles, and its greatest width about sixty miles, giving an area of about six thousand square miles.

It is drained by the Rio Grande and the tributaries which flow into it. These small streams descending from the surrounding mountains traverse the central plains and valleys, which all incline toward the Rio Grande, or central artery, except in the northern section. Here there is an isolated basin some thirty or thirty-five miles long and about twenty or twenty-five in width; into this the streams from the east, north, and north-west flow, depositing their waters in the chief depression, on the east side, where, in the spring and early part of the summer, they doubtless form a lake of several miles in extent. But this in the fall,

as the snows on the eastern range disappear, decreases until it is only three or four miles in length, and is surrounded by a marsh covered with a rank growth of tall grass and shrubbery.

The streams throughout the park which descend from the mountains afford a means of irrigating the valleys and plains through which they run, with very little cost; their channels being cut but a few feet below the surface level, the water is easily turned wherever desired. Doubtless a large portion of the elevated plateaus bordering the Rio Grande may be irrigated from this stream, but this will require a considerable outlay in constructing the *acequia madre*, or mother ditch, which will of necessity be several miles in length. But this would bring into use a large body of excellent land which cannot be otherwise irrigated.

The surrounding mountain sides present a broad fringe of timber, chiefly pines, fir, and aspen. Along the borders of the larger streams at various points are growths of cotton-wood. Wheat, oats, barley, and potatoes, turnips, onions, cabbages, &c., grow finely and produce abundant crops. Indian corn can be raised to a limited extent, yet it will never prove a remunerative crop in this valley or park. The smaller fruits, as strawberries, raspberries, gooseberries, currants, &c., grow and produce well, and the region may perhaps be adapted to apples and cherries, but the peach will scarcely mature its fruit.

The foot-hills and mountain slopes are covered with a luxuriant growth of nutritious grasses, which afford a rich pasturage during the entire year for cattle and sheep. And as but little snow falls during the winter, stock can be pastured the year round without other food. No better place for dairy production can be found in the West than in these parks and mountain recesses and valleys.

The most remarkable feature in this unique region is a circular depression in its central part, twenty miles in diameter, resembling the crater of an extinct volcano. It is surrounded by a circular wall or "barranca" five hundred feet high, composed of lava, pumice, calcined lime, metamorphosed sandstone, vitrified rocks, obsidian, and other volcanic products. This barranca is perforated by the Rio del Norte, Culebra, and Castella Rivers; corrosive forces have also in some places broken it into hills. The bottom of this crater is filled with soils resulting from the abrasion and disintegration of the various strata brought down by the streams; it is of surpassing fertility, and thoroughly drained by underlying peat. Access to this park is gained by natural passes through the mountain rim. From a pamphlet entitled "The Geography, Descriptions, and Resources of Central and Southern Colorado," published by the Board of Trade of Southern Colorado, the following statistics in regard to San Luis Park and Arkansas Valley are obtained. It contains a population of 15,200, mostly of Mexican and mixed bloods of a very primitive and unprogressive character. About 8,000 acres have been brought under cultivation, according to the rude processes practiced by such people, and represent with their improvements a cash value of about $80,000. For irrigating canals nearly $18,000 have been expended, a sum which, considering the great natural facilities presented, represents quite a fertilizing power. The live stock owned in Costilla and Conejos Counties, which include the park, embraces 10,000 cattle, 260,000 sheep, 2,000 hogs, and 2,000 horses and mules, worth in the aggregate $1,000,000. During the year 1869 the crops included 7,000 bushels of corn, averaging twenty-three bushels per acre, 24,000 bushels of smaller grains, averaging forty-seven bushels per acre, and 7,000 bushels of potatoes. Of wool 500,000 pounds were produced, and of butter or cheese nearly 10,000 pounds, worth in all over $100,000. The average cost of

subsisting cattle is reported at $1 75 per annum, and sheep 25 cents. The value of farming implements was $14,000; lumber was manufactured to the value of $17,000. Merchandise weighing 550,000 pounds was imported, the freight charges amounting to $50,000. One thousand dollars' worth of articles was manufactured at home. The gross sales of merchandise were $300,000.

The other great parks, stretching northward to the Wyoming boundary, reproduce the main features above detailed with minor variations. The South Park, sixty miles long by thirty wide, on the east side of the main continental divide, contains the head-waters of the Arkansas and South Platte Rivers. It is thought to surpass the other parks in beauty and sublimity, but its greater altitude and its more northern latitude render it less available for agriculture than San Luis Park. As a grazing region it cannot be surpassed, having especial advantages for sheep raising. Wide areas of prairie, the richness of which needs only a higher temperature and a more copious rain-fall to develop great values, extend to the foot-hills of the mountain ranges, the heavily wooded slopes of which are overtopped by peaks of perpetual snow. It is well watered for purposes of irrigation, and contains large tracts of valuable timber. Its mineral deposits have attracted a large immigration. The pass through the dividing ridge between the head-waters of the Grand and South Platte Rivers is 11,200 feet above sea level. The mountain streams are well stocked with trout.

Middle Park, next northward on the opposite or west side of the great divide, is drained by the affluents of the Colorado of the West. It is seventy miles long by fifty wide, divided by ranges of hills into three subordinate basins. Its scenery is less romantic than that of the South Park, though the great peaks of the Territory, Long's Peak, Gray's Peak, Mount Lincoln, and other snow-capped mountains encircle it. Its agricultural character has not been tested, but the analogies of position seem to indicate that it is fitted mainly for stock-raising. North Park, again alternating its position on the main continental "divide," extends to the north line of the Territory, and within forty miles of the Union Pacific railroad. It gives rise to the North Platte River, and other streams well stocked with trout. Its sage brush, buffalo grass and wooded hill-sides offer great attractions for wild game, which is found by the hunter in great profusion. It is stated that its valleys abound in small fertile tracts available for immediate agricultural settlement, but its capacities in this respect will scarcely be found equal to those of the more southern parks. A mining immigration has already been inaugurated, and some of the smaller valleys have been settled for farming purposes. A great number of smaller parks, miniature reproductions of the foregoing, are found in the mountain region, giving scope for a considerable amount of agricultural enterprise.

The third grand division includes that portion of Colorado east of the Rocky Mountains, properly known as the "Plains," and is subdivided by its chorographic features into two basins, the South Platte and the Arkansas Valleys. The Platte Valley, till lately, has indicated greater mineral than agricultural resources, but the advent of a progressive class of immigrants from the States to the eastward has developed an unexpected value of cultivable and grazing land. Many fine bottoms have been found immediately available, while a still greater surface is reclaimable by irrigation at no great expense. Its agricultural products amounted to more than half the entire aggregates of the Territory in 1867, and were doubled the following year, the whole Territory advancing only fifty per cent. Crops of sixty bushels of wheat, and of two

hundred and fifty bushels of potatoes are frequently reported. The averages, however, are much less than these figures, and may be expected to decrease as the virgin freshness of the soil is exhausted. Melons and vegetables are superior in size, quality, and productiveness. The irrigated gardens of this section produce cabbages weighing from fifty to sixty pounds, potatoes from five to six, onions from two to three, and beets from ten to fifteen pounds. Scarcely a beginning has been made to the occupation of the arable lands, not to speak of the irrigable lands of this region. The Cache à la Poudre Valley, a branch of the Platte, has about 100,000 acres of tillable lands, of which not more than 5,000 or 6,000 acres are in cultivation. Its oat crop averaged forty-eight and a half bushels per acre, and cows paid for themselves in a single season in butter and milk. The northern affluents of the Platte are best fitted for cereals and potatoes, while in the southern valleys the temperature admits of considerable corn and fruit production. The superior character of the agriculture of this region is due to the fact that the farmers are mostly Americans, animated by the progressive impulses of a higher civilization.

The Arkansas Valley, in the south-east, possesses some advantages for agriculture over other parts of the Territory. Prominent among these is its lower altitude, its basin ranging from 3,500 to 4,500 feet above sea level, about 1,500 feet below the average level of the Platte Valley. This secures a greater geniality of climate, its winters being mild, and its summers, though long and warm, by no means oppressive. Its bottoms are of unsurpassed fertility, while its broad table-lands seem to afford facilities for stock-raising practically inexhaustible. This region is now receiving from the East a large civilized population. American farmers already predominate in the tracts bordering on the Arkansas and its branches, and the old system of Mexican agriculture, with its rude, ineffective processes, its serfdom, and other barbarian adjuncts, has been exploded. The great richness of the valleys admitted a quiet, Arcadian simplicity and a superficial social organization, but immigration has broken this lethargy, and infused new life into agriculture.

In this section of the Territory, as appears from the pamphlet heretofore referred to, about 80,000 acres has been brought under cultivation, and represent with all improvements a cost value of nearly a million dollars. In irrigating ditches about $350,000 has been invested with marked beneficial results. The following is an approximate statement of the amount of its live stock in 1869: 4,500 horses and mules; 75,000 cattle; 300,000 sheep, and 5,500 hogs, worth in the aggregate $3,000,000. The crops of the same year include 400,000 bushels of corn and about 300,000 bushels smaller grains, besides about 4,000,000 pounds of vegetables, with an aggregate value of nearly a million dollars. The corn crops averaged twenty-six bushels, and the smaller grains thirty-one bushels per acre. About 50,000 sacks of flour were manufactured; the wool product amounted to nearly half a million pounds; 5,000 fruit trees were under cultivation; 4,000 gallons of wine were made, and 130,000 pounds of butter and cheese; the value of these minor products was not less than $350,000. The value of farming implements amounted to nearly $100,000. The average cost of keeping cattle per annum varied in different counties from $1 50 to $3 25 per head; and of keeping sheep from 25 cents to 75 cents per head. Lumber was manufactured to the amount of nearly $300,000. Over $50,000 worth of home-made articles was manufactured, while the gross sales of all kinds of merchandise approached $1,500,000. The amount of freight received was over four and a half million pounds, on which the transportation charges were $225,000.

The white population of this valley in 1869 was about 10,000, and is rapidly increasing.

The returns of the crops of Colorado for the year 1869 foot up as follows: Wheat, 675,000 bushels; corn, 600,000 bushels; oats and barley, (nine-tenths oats,) 550,000 bushels; potatoes and other vegetables, 350,000 bushels, which, with the hay and dairy product, will have a market value of not less than three and one-half millions of dollars.

From the foregoing brief survey of the character and resources of Colorado, it will be seen that its splendid mining deposits are supplemented by agricultural resources scarcely less rich and extensive. For industrial or commercial enterprise, or as an agreeable residence, it affords inducements surpassed by no other portion of the public domain. The public land system has been thoroughly inaugurated in the Territory, 4,356,831 acres having been surveyed up to June 30, 1869, leaving 62,526,169 acres yet to be surveyed. The lands are appropriated about as fast as the public surveys are executed. Among the encouraging indications already observed since the settlement of Colorado, the amelioration of the climate by the increase of annual rain-fall has attracted much attention. The Cache à la Poudre, according to the reports of settlers, is annually enlarging the volume of its waters. Streams which seven years ago dried up every summer, now preserve an unbroken current during the whole year. The steadiness with which this encouraging feature has increased from year to year argues the presence and operation of ameliorating causes. The opinion is extensively entertained among the settlers that ere long the excessive aridity which has crippled agriculture in the plains of Eastern Colorado will be entirely removed; and the hope is expressed that agricultural settlements will ultimately spread from the foot-hills of the Rocky Mountains eastward, and from the fertile valleys in all directions to cover the entire region.

Although the attempted artesian well far south on the great Staked Plains proved a failure, there is reason to hope that when the attempt shall be made in these eastern plains of Colorado and Wyoming it will prove successful.

DAKOTA.

This Territory, lying between the parallels of 42° 30′ and 49°, and between the meridians 96° 25′ and 104° west from Greenwich, embraces an area of one hundred and fifty thousand nine hundred and thirty-two square miles, or 96,596,480 acres. It constitutes a grand territorial reserve, from which at least three States, each much larger than Iowa or Missouri, will in a few years be erected. The separation of the Territory of Wyoming has destroyed the hopes of an extensive development of mineral resources in Dakota, and confined the production of raw material mostly to agriculture. Indications in this direction, however, are highly satisfactory. Governor Faulk, in his annual message to the territorial legislature, in December, 1868, declares that the Territory east of the Missouri River embraces one of the finest agricultural districts on the continent. West of that river the presence of fifty thousand hostile Indians prevents the exploration of natural resources necessary to establish the true agricultural character of the country. These Indians manifest a stolidity of character, and an inaccessibility to civilizing influences, which are remarkable even in this strange race of men. Their traditional prejudice against the whites, aggravated by the evils which the approach of civilization never fails to inflict upon savage tribes, has

made them exceedingly jealous of all attempts to penetrate and explore the country. For a thousand miles along the Missouri River the voyager will see a wilderness unbroken save by a few straggling Indian villages, or by a few military or trading posts. The necessities of the mining population of Montana, and of the military establishments of the general government, require the annual shipment to Fort Benton of at least 15,000 tons of merchandise, employing about fifty steamers on the Upper Missouri. This trade is increasing in volume and value, and is multiplying facilities for obtaining the desired information. The deposits of the precious metals known to exist in the Black Hills, less than two hundred miles distant, will soon supply strong motives for the exploration of this *terra incognita*. As the glittering sands of California attracted a civilized population which soon detected untold agricultural resources in the soil, so we may expect that the adventurous spirit of our mining population will soon settle the agricultural character of Western Dakota by a thorough occupation of the country.

The climate of this region is dry, pure, equable, and invigorating. Epidemic and contagious diseases are unknown. Blodgett's charts exhibit a remarkable northward tendency in the isothermal lines, the mean annual temperature varying from 35° to 45° Fahrenheit. The meteorological tables of the Dakota Historical Society show that the temperature of the settled portion of the Territory, during the year 1865, ranged between 20½° and 104° Fahrenheit. The winter temperature is low, as might be expected in this high latitude, but the comparative dryness of the climate and the abundance of natural grasses enable the farmer to winter his live stock without shelter, and at small cost for subsistence.

In the southwestern portion of the Territory, the extension of the *mauvaises terres* (bad lands) of Nebraska renders a considerable area unavailable for present settlement. This mysterious region, so puzzling to the geologist as well as to the antiquarian, must await the developments of economic science to fit it for the abode of man. The surveyor general of Dakota estimated these "mauvaises terres" within the Territory at 32,192,709 acres. Add 10,000,000 acres for mountains and other sterile lands, and we find about 42,000,000 acres unavailable for agricultural purposes. The residue of the Territory, over 54,000,000 acres, is agricultural land, of which 32,120,000 are arable, and the remainder good grazing land. About one-eighth of the surface of the State promises good returns to mining enterprise.

Of the sterile lands above mentioned, 2,560,000 acres are covered by the Black Hills, a range about one hundred miles long by sixty in breadth, trending north 20° west. About two-thirds of this range lie in Dakota and one-third in Wyoming. The timber lands of the Territory embrace nearly a million acres, or about one per cent. of the entire surface. Immense forests darken the declivities of the Black Hills, their heavy shading, as seen from a distance in the clear atmosphere, suggesting their name. In the surveyed portions of the Territory, especially east of the Missouri River, timber is found only in belts fringing the lakes and rivers. In this portion of the Territory it is supposed to average not more than one acre to each square mile.

So far as is now known, the most valuable portion of the Territory lies east of the Missouri River, extending westward from the Minnesota and Iowa boundaries to the sixty-second range of surveyed townships. It must be remembered, however, that this area includes only the surveyed portion of the Territory. It is thought by persons acquainted with the country that the extension of the public surveys westward of the Missouri will develop a more favorable agricultural character than

the official estimate above given. The right bank of the river and the valleys of its western tributaries are known to embrace considerable bodies of good land. The fact that fifty thousand wild Indians still maintain themselves in this region in considerable independence of civilization gives ground for the supposition that its resources have been underrated.

The extension of the Missouri River trade indicates a speedy enlargement of agricultural production in the settled portions of the Territory, by opening home markets for produce. The bottoms of the great river and of its eastern tributaries have a remarkable richness of soil, and a luxuriant growth of indigenous nutritious grasses, while the uplands consist very largely of rolling, well-watered prairies. The soil consists of well-pulverized mold, mingled in small proportions with clay and fine sand, while the absence of underlying "hard pan" enables it to withstand the untoward influences of extremes of both drought and moisture. It has also a remarkable freedom from those malarious exhalations which have been the scourge of pioneer immigration. The United States surveyors report no swamp lands in the Territory. All kinds of grain and vegetables grown in the north-western States can here be produced in great abundance and of excellent quality. The crops of Dakota for 1869 exhibited the general luxuriance and excellence which marked the entire Missouri Valley. Even corn yields a very promising crop for this latitude. Wheat shows returns reaching in several localities forty bushels per acre. Oats yielded from fifty to seventy-five bushels per acre, in several authentic instances reaching a maximum of eighty-five or ninety bushels. The other small grains are equally prolific, while the crops of potatoes and other vegetables are unsurpassed in the entire northwest.

The area of cultivation is rapidly expanding. Apprehensions of drought, founded upon the limited annual deposit of atmospheric moisture have been dissipated by the experience of the seasonable distribution of rains during the growing seasons. The policy of tree planting and forest culture, which has been pursued with such beneficent results in Nebraska, and other portions of the public domain, will doubtless be introduced into Dakota, increasing the fall of rain and otherwise enhancing the agricultural value of the soil. The extension of the area of cultivation will have the same general influence. The danger of Indian incursions becomes less imminent every year. The removal of these obstacles has induced a large immigration of agricultural settlers, which promises a rapid and continued increase in coming years.

The valley of the Red River of the North is probably the best part of the Territory for agricultural enterprise. Its climate is milder than in the same latitude to the eastward. The soil is remarkably well adapted to the smaller grains. It is well watered and of good natural drainage. In the neighborhood of Minne Wakan or Devil's Lake, are considerable supplies of timber. To the westward reports of topography are not so favorable; small lakes are drying up, and the water remaining in their basins is in some cases decidedly alkaline. The Dakota, Big Cheyenne, and other eastern tributaries of the Missouri have clear streams of excellent soft water, but the waters of Devil's Lake are strongly impregnated with salts of an alkaline character. No fish are found here, except a few pickerel near the mouths of fresh-water streams.

In the latitude of Yankton, the capital, and northward to the center of the Territory, the attractions for agricultural settlers are more appreciated as they become better known. During the month of June, 1869, about 47,000 acres of public land were taken up by actual settlers,

under the land laws. At least 12,000 acres were cultivated during the past season. With the present tide of immigration, it is thought that Dakota will soon rival Minnesota in the amount of its wheat production. The total area of lands in the Territory surveyed up to June 30, 1869, was 4,878,948 acres, with large appropriations available for the extension of the surveys. The area of public land remaining unsold and unappropriated at the same date was 90,890,000 acres.

MONTANA.

Montana may also be regarded as an immense reserve of territory for the creation of new States, having ample area for at least five of the largest class. It extends along our northern boundary from the one hundred and fourth parallel to the one hundred and sixteenth, with an average breadth of four degrees of latitude, covering an area of one hundred and forty-three thousand seven hundred and seventy-six square miles, or 92,016,640 acres. Its name indicates its prevailing chorographic character, and is but a translation of the Indian name "Tay-a-be-shock-up," or "Country of the Mountains." It may be divided, for description, into five large basins, four of which lie east of the Rocky Mountains, and one to the westward, flanked by the Bitter Root and Cœur d'Alène ranges. These basins are broken into a number of minor valleys, separated by spurs, often of great elevation, projecting from the main mountain ranges. This western basin is mostly drained by streams emptying into the Flat Head and Pend d'Oreille Lakes. The former, lying near the British frontier, is thirty-five miles long by fifteen wide, and is surrounded by a beautiful country, a considerable portion of which is of excellent agricultural character. Southward the country exhibits great capacities for grazing, while the bottoms of the Missoula River, and of its tributaries, the Bitter Root and Hell Gate Rivers, show large bodies of excellent arable land.

The first essays of agricultural enterprise in the Territory were made by the Jesuit missionaries some twenty-five years ago. They received poor returns for their labors, which, it has since been found, were not conducted with any agricultural skill, or at best with but little adaptation to circumstances, inasmuch as upon the same soil during the past two years very fine crops have been produced, which, with each year's experience, promise to become yet more abundant. So far as the country has been explored the indications are that this western basin is the most valuable part of the Territory. It is about two hundred and fifty miles long by seventy-five in breadth. It is comparatively well wooded, large bodies of timber having been reported in several localities; the slopes of the mountain ranges are generally covered with heavy timber. It contains eight principal valleys, viz: Flat Head, Mission, Jocko, Hell Gate, Bitter Root, Big Blackfoot, Flint, and Deer Lodge, with many smaller ones of great beauty and fertility. This region is open, to a considerable extent, to the moist winds of the Pacific, a circumstance which accounts for its luxuriant vegetation.

The north-east basin extends from the Rocky Mountains to the eastern border of the Territory, a length of six hundred miles by one hundred and fifty. The eastern portion of this basin contains an extensive area of the "mauvaises terres" of Dakota and Nebraska, but these are interspersed with fertile belts along the banks of the streams, the principal affluents of the Missouri being the Milk, Marias, Teton, Sun, and Dearborn Rivers. A very large proportion of lands naturally unproductive may be reclaimed by irrigation, the presence of snow-clad mountains, in single peaks and in ranges, affording great facilities. The lack of

timber, so far as fuel is concerned, is amply compensated by immense beds of coal, the existence of which is demonstrated by recent geological surveys.

The south-western basin is drained to the east by Jefferson's Fork of the Missouri, and by its tributaries, the principal of which are the Big Hole and Beaverhead Rivers. It approximates the shape of a spread fan, being about one hundred and fifty miles long by one hundred broad. Quite a number of mining settlements have been made in this region, but its agricultural character is not so easily made out from authentic reports. It is a region the topography of which attests the working of powerful geologic changes during the pre-historic period. Traces of glaciers are plainly visible. It has large beds of mineral coal.

The central basin, along the main line of the Missouri, is about one hundred and fifty miles long by eighty broad. It contains a large area of arable land, with a climate of great mildness, considering the latitude. It embraces five large valleys, viz: Three Forks, North Boulder, Lower Jefferson, Madison, and Gallatin.

The great basin of the Yellowstone and its branches covers the remainder of the Territory. It is four hundred miles long, with a breadth of one hundred and fifty miles. The hostility of the Crow Indians has prevented any exploration of the country, and, consequently, its agricultural character cannot yet be determined. In climate and fertility, however, it is thought to be a medium between the mountain valleys and the prairie bottoms. Corn, beans, and pumpkins are known to thrive. The basin embraces several principal valleys, such as the Yellowstone, Shields's River, Rosebud, Clark's Fork, Pryor's Fork, Bighorn, &c. The Yellowstone River is navigable for light-draught steamers nearly through the basin to the center of the Territory.

The yield of cereals in different parts of the country is very encouraging. Wheat returns from thirty-five to fifty-five bushels per acre, many localities averaging forty bushels. One field in the Prickly Pear Valley produced fifty-seven bushels to the acre. Flour is extensively manufactured in the Territory, good water power being thus brought into action. Oats average fifty bushels, reaching a maximum of seventy-five; they are remarkable for great weight per bushel. Potatoes average two hundred bushels, and barley seventy-five bushels. A similar abundance is reported in regard to other grains and vegetables. After seasons of heavy snowfall the advantages of thorough irrigation enlarge the capacity of the soil for abundant crops. Cultivation has extended from the valleys to the foot-hills of the different mountain ranges, and, for many agricultural purposes, these are considered the best lands in the Territory.

The aggregate values of agricultural produce for 1869 are estimated by the surveyor general as follows: Wheat, $900,000; barley and oats, $500,000; potatoes, $1,000,000; hay, $200,000; vegetables, $75,000; poultry and eggs $100,000, butter, cheese, and milk $400,000. There are in the Territory cattle valued at $450,000. The lumber trade produced $300,000.

There had been surveyed in the Territory prior to June 30, 1869, 819,372 acres. It is estimated that 30,672,213 acres (about one-third of the entire Territory) are capable of profitable cultivation; this estimate includes areas requiring irrigation.

The estimated amount of mineral lands is 9,200,000 acres; of timbered lands 11,502,320 acres, or about twelve per cent. of the entire Territory. At date of June 30, 1869, there yet remained at the disposal of the government 86,887,316.76 acres of public land.

The construction of the North Pacific railway through this region will develop an amount of resources at present unappreciated. While furnishing the shortest highway across our continent, it cannot fail to awaken a local trade which will ere long tax its full powers of transportation. As a theater of agricultural settlement to parties seeking a higher latitude Montana presents many very substantial attractions. The tide of immigration is increasing, and the final subversion of the power for mischief, now held by the Indians within the Territory, will remove the great obstacle to the occupation of the country by a civilized population.

IDAHO.

Idaho is an irregular wedge-shaped Territory, on the western declivity of the Rocky and Bitter Root Mountains, originally included in Oregon, and subsequently, in part, in Washington Territory. Its width narrows to the northward from six degrees of longitude, or three hundred and nine miles, on the forty-second parallel, to one degree, or forty-five and one-half miles, on the forty-ninth parallel, our national boundary. Its extreme length, extending through seven degrees of latitude, is nearly four hundred and ninety miles. Its area is eighty-six thousand two hundred and ninety-four square miles, or 55,228,160 acres.

Lying west of the great continental divide, its water drainage is exclusively to the westward, through the Columbia and its affluents. These streams afford considerable facilities for communication with the Pacific coast, but are far more valuable on account of the enormous amount of water-power which they afford. The entire basin of the Columbia River, of which Idaho forms a part, is an elevated plateau rising from one thousand to six thousand feet above sea level. The rivers, rising in the eastern ranges of mountains, have an average fall of ten feet per mile, creating a general rapidity of current with occasional cataracts.

The northern portion of the Territory, above the North Fork of Clearwater River, to the British frontier, is composed of mountains interspersed with lakes, often of exquisite beauty, among which the most important are Lakes Rootham and Pend d'Oreille. These lakes are surrounded by considerable bodies of land available for agriculture. With the exception of these and of the river bottoms it is probable that but little arable land will be found, but grazing lands are doubtless more abundant. The climate exhibits low winter temperatures as compared with the same parallels both east and west. The mountainous character of the country causes a rapid southward deflection of isothermal lines. This region is, as yet, but thinly inhabited by white people, but large tracts have been reserved by treaty for the occupancy of the Cœur d'Alène, Nez Percés, and other Indian tribes. These aborigines will soon be intruded upon by restless miners prospecting deposits of precious metals known to exist in that quarter; they would be likely to remain long undisturbed by agricultural settlers, but for the anticipated speedy construction of the Northern Pacific railroad, which will inevitably attract a large civilized population.

The central district, from the Boise River to the Clearwater, consists of table-lands, rich in grasses, heavily timbered mountains, and fertile valleys. Among the latter the most attractive are the Clearwater, Salmon, Payette, Wood, Weiser, St. Joseph, and Cœur d'Alène. These valleys are all exceedingly well watered, and endowed with extraordinary fertility of soil. With the aid of irrigation, for which ample facilities exist, these lands produce abundant crops of wheat, barley, rye, and oats, as well as the fruits and vegetables of the States north-west of

the Ohio River. This region is also well timbered; its vast wooded areas will furnish abundant supplies of lumber and fuel. These magnificent forests not only add a conspicuous beauty to the landscape, but also contribute greatly to the salubrity and humidity of the climate. This portion of the Territory will long continue the favorite of agricultural immigrants, especially along the affluents of the Snake River.

The southern portion of Idaho, from the Boise River to the forty-second parallel, the boundary of Utah and Nevada, consists of fertile valleys traversing sage-brush plains and table-lands, with a very small proportion of timber; the latter is of an inferior character, consisting mostly of cotton-wood along the streams, and of fir and juniper in the mountains. Three-fourths of this district, or one-half the area of the Territory, is at present unfit for cultivation, but it is capable of reclamation by irrigation, when it will produce abundant crops, at least equal to those of second-rate soils. In the south-west corner of this district are several fertile valleys tributary to the Owyhee, which have already been occupied by agricultural settlers.

The mineral resources of the Territory have already attracted a population estimated as high as fifty thousand. A home market for produce has thus been created which will afford unusual inducements to agricultural industry. The climate of the different zones is, of course, of great variety. Through the spring, summer and autumn the temperature is sufficiently high for cereal production and for agreeable residence. In the southern parts of the Territory the downward thermometric range is limited by air currents from the Pacific coast.

The mountains of Idaho are of great elevation, many of the peaks rising above the line of perpetual snow. Their slopes are furrowed by copious streams, and checkered with alternate tracts of forest and rich prairie. The plains are covered with indigenous grasses of nutritious quality, affording unsurpassed facilities for stock-raising. The cañons in the lower valleys often afford all the shelter necessary for wintering stock, while the pastures, covered with snow but for a portion of the year, present a cheap and effective subsistence. The grass drying on the stalk is naturally cured into hay of a superior quality. It is the custom of herdsmen in Idaho to reserve their lower meadows for winter pastures, allowing their stock to range the higher lands during the milder portions of the year. The greater extent of the table-lands and the adaptability of the bottom lands to cultivation have suggested the economic value of this method. The sheltered position of the valleys is also favorable to fruit culture by protecting the orchards from the cold blasts of winter. Even the least favored regions are studded with localities favorable to specific branches of agricultural enterprise, which will ultimately be occupied by a thrifty farming population.

The agriculture of Idaho, though still in its infancy, has made very encouraging progress. Wheat has been produced in crops reaching the maximum of sixty bushels per acre. One year with another wheat will average twenty-five bushels. Oats from thirty-five to forty, and barley from fifty to sixty, sometimes reaching one hundred. In one case fifty-four pounds of wheat were produced from a single square rod, being at the rate of one hundred and forty-four bushels per acre. The wheat produced in this instance has been called "Idaho White wheat," and is thought to be superior. It matures from fall or spring sowing; is white, beardless, and heavy, and produces a large proportion of flour. Vegetables and melons grow to perfection. The Territory is no longer dependent upon Oregon for supplies of breadstuffs and provisions. Flour, which in 1865 cost $50 per sack of fifty pounds, can now be had

at $3 per sack, and bacon has fallen from 75 cents to 25 cents per pound. The aggregate agricultural product for 1869 is estimated at $12,000,000. Lumber can be had at the mills for $25 per thousand feet. The completion of the initial line of transcontinental railway, though not crossing any portion of the Territory, has added greatly to its industrial and commercial value. The completion of the Northern Pacific and the Oregon branch of the Union Pacific, which will be accomplished at no distant day, will still further develop these resources.

There had been surveyed within the Territory, up to June 30, 1869, only 510,973 acres, but title had accrued under various land laws to 3,092,331 acres, leaving still at the disposal of the government over 52,000,000 acres. It has been estimated that of the entire area of Idaho 16,925,000 acres are arable, and 5,000,000 more adapted to grazing. Of sterile lands 14,328,160 acres, at present producing no other vegetation than wild sage and buffalo grass, are believed to be, for the most part, reclaimable by irrigation into excellent pasture and arable land. Of the 18,400,000 acres of mountain lands about 7,500,000 are timbered, and 8,000,000 are mineral lands.

WASHINGTON.

Washington Territory extends through nearly eight degrees of longitude, covering about three hundred and sixty miles of the British frontier, with an average breadth from north to south of over two hundred miles. Its area is sixty-nine thousand nine hundred and ninety-four square miles or 44,796,160 acres. The Cascade Mountains, running parallel with the Pacific coast at a distance of about one hundred miles, divide the Territory into two unequal portions of marked topographical and climatic differences. The coast range of California is prolonged, with some interruptions, to the Straits of Fuca. The country east of the Cascades is subdivided by Clark's Fork of the Columbia River, thus constituting three natural grand divisions of the Territory. The western division contains the mass of the population; its resources are now sufficiently developed for a reliable estimate. For the purposes of description this section may be subdivided into three great basins, viz: Columbia, Chehalis, and Puget Sound basins, with an aggregate area of twenty-eight thousand square miles. The Columbia basin, back from the river bottoms, is generally high and often broken, with a soil composed of a mixture of clay and loam well adapted to the production of indigenous and imported grasses. The river bottoms are very fertile, but their slight elevation exposes them to frequent overflows. The freshets of the Columbia, resulting from the melting of mountain snows more than from rainfall along its valley, do not generally occur before the middle of June, a season very inopportune for agricultural operations. In the Cowlitz Valley, and other portions of the Columbia basin, are found considerable tracts of rich bottom and prairie land, but this region, on the whole, presents greater attractions to stock-raising than to agriculture. North of the Columbia is the Chehalis basin. The narrow valley of that river, embracing two thousand square miles, contains the finest body of agricultural land in the Territory, and well deserves its cognomen, "the garden spot of Washington." It extends from Gray's Harbor to the foot of the Cascades, the river being navigable for light-draught steamers for over sixty miles. The valley varies in width from fifteen to fifty miles, and is largely composed of rich bottom lands, back of which are hills and table-lands valuable both for cultivation and grazing. This region is rapidly filling up with a permanent and thrifty population. South of Gray's Harbor is Shoalwater Bay, draining seven hundred

square miles. Much good land is here found, especially upon the Willopah River, a considerable stream, entering the bay from the east. North of Gray's Harbor and west of the Cascades, the country is but little known, thick forests and undergrowth rendering the extension of surveys in this direction very difficult and expensive. This tract, however, is supposed to contain many localities eligible for agricultural settlement.

The Puget Sound basin, embracing twelve thousand square miles, extends to the British line. The soil is generally gravelly, except along its numerous water-courses, where rich alluvial deposits abound. Beds of coal crop out at frequent intervals, indicating a good supply of mineral fuel. This region is favored with an extensive system of internal navigation, by means of the rivers, inlets, and other ramifications of Puget Sound and Admiralty Inlet.

The whole of Western Washington is bounteously furnished with excellent timber. The country west of the Coast Mountains and north of Gray's Harbor, a plateau twenty to thirty miles wide, is covered with an almost unbroken forest, watered by many beautiful mountain streams. Extensive forests cover the regions around Admiralty Inlet and Puget Sound. The flanks of the Cascades are covered with the finest timber. The commercial facilities afforded by the network of internal navigation have given rise to an immense export of lumber, estimated at nearly $3,000,000 per annum.

The climate of Western Washington differs essentially from that of the eastern section. The lofty range of the Cascades, bisecting the rain-bearing strata of the atmosphere, arrests the eastern passage of the humid air of the ocean, and compels its deposit in immense quantities in the coast region. The atmospheric currents are regulated by causes producing a remarkable equilibrity and a comparatively narrow range of temperature, dividing the year practically into but two seasons, the wet and the dry. This class of climatic conditions is very favorable to the cultivation of small grains; corn cannot flourish for the lack of high summer temperatures; but wheat, barley, and rye present average crops equal to any on the continent. It is also admirably adapted to stock-raising; the mild winter temperature, and the abundance of rich natural grasses, render the wintering process comparatively inexpensive, thus enlarging the margin of profits of this branch of agriculture.

Wheat yields forty bushels to the acre, averaging over twenty-five bushels, one year with another. Barley yields an average of thirty-five bushels, rising to a maximum of eighty bushels. Oats yield from forty to fifty bushels. Potatoes generally return about three hundred bushels. The wheat sown in the southern parts is chiefly white wheat, it being the most productive in grain, and yielding the largest proportion of flour. In the northern part the Mediterranean spring wheat is preferred. This grain suffers very little from rust, weevil, or smut, and is generally harvested in a sound, healthy condition. Its cost of production is under 80 cents per bushel, and the market price generally over $1, yielding a fair margin of profit. Hop culture has been introduced; in one case 5,000 pounds are said to have been produced on two acres. Hay, mostly herd's-grass, averages two tons per acre, and commands about $8 per ton in the market. Clover, two crops per annum, yields over two tons per acre, worth $12 per ton. Fruit culture promises rich results. In one county the apple crop was so abundant as to overstock the market; the surplus, however, was profitably fed to hogs. Pears, plums, cherries, gooseberries, peaches, and other fruits, bear early and profusely in the settled portions of the country, produc-

ing fruit of excellent quality. The orchards being yet young, and the cultivators comparatively inexperienced, it may fairly be presumed that the capacities of this branch of agricultural industry are but partially indicated by the results already obtained.

The small fruits grow in great perfection, and have thus far been entirely free from the ravages of the curculio and other destructive insects. The mildness and humidity of the climate produce some very singular effects upon vegetation. In many localities cabbages, potatoes, and other garden vegetables are harvested only as they are required for family use. Cabbage-stalks left standing in the ground often produce three to seven heads subsequently to the decapitation of the first. These subsequent heads, though of diminished size, are hard, sound, and excellent.

Owing to the decline of mining operations in British Columbia, and to the high tariff imposed upon produce imported into Victoria, the value of farm lands in northern parts has declined, in some instances fifty per cent. below the prices of 1860. This influence has been felt to some extent further south, but here it is counteracted by a rapid increase of settlement, and a general extension of commerce. In the southern counties good bottom land, improved, commands as high as $10 per acre. Here the price of lands has generally advanced. The unimproved timber lands bordering on the Straits of Fuca are still regulated by the government minimum of $1 25 per acre.

The fisheries of this part of the Territory are important. Salmon of superior quality are found in the Columbia River in great abundance, and in the spawning season millions of them perish from overcrowding. This feature becomes still more marked in the streams and inlets north of the Columbia. Oyster fisheries are extensive and increasing, about forty thousand baskets being shipped annually to San Francisco. The cost of production is about 25 cents per basket, and the market price about $1. This industry is fostered by the government, a grant of ten acres being made to each person who will plant an oyster-bed.

Of the eastern portion of the Territory our knowledge is chiefly limited to the reports of explorers, in default of general settlement. The central district, lying between the Cascade Mountains and the Columbia River, with the exception of the Valleys of Yakama, Methow, Okinayum, and Ne-hor-at-pu-gum, is generally sterile, stony, and arid. Timber is scarce except in the above named valleys, which present considerable bodies of arable and grazing land, with well-wooded tracts. Good building pine is found on the Yakama.

The general altitude of this whole basin is from one thousand to two thousand feet above sea level, with no drainage except through the Columbia and its affluents. The formation is basaltic, sometimes columnar, but generally irregular. The soil varies in depth and easily crumbles to an impalpable powder, which is frequently impregnated with alkali, crystallizing by evaporation and remaining during the dry season as an efflorescence. The streams often run through cañons fifteen hundred feet deep, which, however, are so narrow as to be not easily observed on the surface. Strips of rich alluvions are frequently found in these cañons. The structure of these basaltic regions does not give ground for any judicious hope of supplying the surface moisture by artesian wells. Watering-places are ten to twenty, and often fifty miles apart. Artificial irrigation has not been attempted on any considerable scale. The depth of the cañons through which the rivers flow indicates that the level of the water is so far below the soil as to render this process, as a general thing, entirely impracticable in this region.

The country east of the Columbia presents the same general characteristics, being of the same basin. From the southern boundary of the Territory to the Spokane River, a distance of nearly one hundred and fifty miles, is found a vast unbroken prairie, save the slopes of the mountains, which are covered with evergreens. The surface is high, rolling, and irregular, with occasional plains, in which the irregularities seem to have been shaved off by glacial action, and deposited in windrows on lower levels. Between the Snake and Spokane Rivers the soil has thus been swept off from large tracts, and piled in heaps resembling haystacks.

North of the Spokane River, however, the geology, topography, and climate undergo a remarkable change. The basaltic formation gives place to quartz, slate, and limestone. The surface breaks into hills and valleys, with fair supplies of timber, and indicates a very hopeful agricultural character. The Walla-Walla Valley, in the southeast corner, embraces a million acres of excellent arable land, and has quite a numerous population. In this valley improved land commands $2 per acre, presenting great facilities for either cultivation or grazing. Wheat, hay, and apples are the principal crops thus far raised. Wheat is raised by nearly all the farmers, and averages 25 bushels per acre; the yield of the entire valley, for 1867, was 75,000 bushels, about 55,000 being winter wheat. Oats average 30 bushels; corn, 40 bushels; rye, 20 bushels; peas, 40 bushels; beans, 36 bushels; potatoes, 300 bushels; sweet potatoes, 200 bushels; turnips, 300 bushels; carrots, 1,000 bushels; parsnips, 800 bushels; cabbages, 20,000 pounds; hay, 2½ tons. Fruit culture promises to rival the crops of the most favored localities of Western Washington. Apple trees average 250 pounds each, in the fourth year after planting; peaches, 200 pounds; pears, 250; plums, 250; cherries, 250, &c. Small fruits present encouraging averages. Peaches are very thrifty, and command, at present, $4 to $12 in gold per bushel; but these high prices cannot continue when the culture becomes general.

Beef and wheat are the chief exports of the Walla-Walla Valley. Its excellent grazing facilities give great advantage in production, while the presence of large mining populations in Montana and Idaho affords excellent markets. In the Columbia and Pelouse Valleys are many bodies of excellent land, which, when brought under cultivation, will probably present results equal to those of the Walla-Walla.

The climate of Eastern Washington, in regard to temperature, is about on a par with that of the portion of Pennsylvania which lies within the same geographical parallels as Utah, Nevada, and Northern California. The average annual fall of rain, however, is but one-fourth of that of the Puget Sound basin. Coal of excellent quality is found both east and west of the Cascades.

The timbered lands of the Territory embrace, in round numbers, twenty millions of acres, and the prairie lands twenty millions more; the waters of the lakes, bays, inlets, and streams, and the irreclaimable mountain ranges, about five millions of acres. Of arable lands there are eight millions of acres, which, with ten millions of grazing lands, make the aggregate of eighteen millions available for agriculture. Up to June 30, 1869, there had been surveyed in Washington 5,063,775 acres. At that date there remained, at the disposal of the government, 41,377,123.96 acres.

Six miles of railroad have been completed, and one hundred and fifty miles have been projected within the Territory. The completion of the North Pacific railroad and its Oregon branch will develop great resources and attract a large population.

UTAH.

Utah, since the transfer of portions of its surface to Nevada and Wyoming, embraces an area of eighty-four thousand four hundred and seventy-six square miles, or 54,064,640 acres. Its maximum length is three hundred and forty-five miles, with an average breadth of two hundred and fifty. It is divided into two distinct regions by the Wahsatch range of mountains, which traverses it from north-east to south-west.

The eastern section is a part of the great basin drained by the Colorado of the West. This basin is an elevated plateau, which has a general level from four thousand to six thousand feet above the sea, and is frequently broken by mountain ranges and by isolated peaks, rising from two thousand to seven thousand feet above the general surface. Of the continuous chains the Uintah mountains, projecting from the Wahsatch range almost directly east to the northwest corner of Colorado Territory, is the most prominent. The crossing of the various ridges and highlands, by the Colorado and its affluents, gives rise to a very remarkable feature in the topography of this region, the deep cañons. These are narrow chasms, cut by the river courses through successive strata, often embracing the hardest rocks. The celebrated Grand Cañon forms a sort of funnel mouth to the beautiful valley in which Green and Grand Rivers unite to form the Colorado. It extends about 400 miles through Arizona and Nevada, with vertical walls rising from five hundred to fifteen hundred feet, the exterior banks rising, in some localities, nearly a mile above the river bed. These walls consist mostly of limestone and sandstone, but frequently present deposits of very excellent marble and granite.

The Colorado and its constituent streams, Green and Grand Rivers, receive about two hundred minor affluents, the united volume of which rushes with rapid current through the narrow cañons, but enlarges into broad, placid streams in the lowlands further down. This basin is but little known, its uninviting character having repelled settlement, while its exploration so far has been but limited and superficial. Large portions of the soil are known to be arid wastes and alkali flats. The depth of the cañons indicates that the water level is too low for purposes of general irrigation, at least upon any principles now known. Fine bodies of fertile land are found on the margin of streams, which might be enlarged by the limited facilities of irrigation. Still wider areas are probably available for grazing. From the present indications, however, Eastern Utah will never be of any great agricultural value.

In announcing this opinion, it is well to call to mind the frequent failures that have been made in prognosticating the future agricultural value of unsettled and consequently unknown portions of the public domain. Mr. Webster, in advocating the admission of California into the Union, did not feel warranted in estimating an agricultural area in the State of over twelve million acres, but by the estimates of the most intelligent statisticians of that State, its agricultural area is little less than ninety millions of acres, of which, at least, forty millions are fit for the plow. The remarkable success of Mormon agriculture in the great Salt Lake Valley, and the changes which an intelligent and persistent industry has wrought in the face of an arid desert, give some reason to hope that the first impressions in regard to the Colorado basin will be reversed as our knowledge of the country increases. The so-called great American Desert, the monument of geographical ignorance and prejudice of the past, has shrunk to so small proportions before the progress of later discoveries, that it is now questioned whether there is

any portion of our national territory that cannot, by improved processes of culture, be made the home of a large civilized population.

The region west of the Wahsatch range is also an elevated plateau, but it presents several remarkable chorographical and topographical differences. It constitutes a part of the Great Salt Lake basin—a region nearly circular in shape, with a radius of three hundred miles, walled in by the Wahsatch and Sierra Nevada ranges on the east and west, and by their connecting off-shoots on the north and south. This great valley differs from the eastward basin in having no outlet for its waters. The Jordan, Ogden, Bear and Weber Rivers, with many smaller streams, empty into Great Salt Lake, a large body of water ninety miles long by thirty wide, with the strongest saline infusion known on the face of the earth. Animal bodies will not sink, and fish cannot live in its dense waters. Its shores, in places, seem to be solid deposits of chloride of sodium. It contains several islands studded with high mountains, upon which, strangely enough, fresh water streams and springs have induced the growth of rich grasses, affording an excellent grazing area.

Perhaps no region was more uninviting for settlement than was this entire region on the arrival of the great Mormon immigration in 1847. It was then within the Mexican republic, and promised a refuge from the hated jurisdiction of the United States. Within a year and a half, however, the treaty of Guadalupe Hidalgo made them again unwilling and disloyal subjects of the general government. Setting up a peculiar institution and organizing a society upon the basis of the most complete centralization of spiritual and temporal power, they grappled with the physical difficulties of the case with a heroism and practical intelligence that have extorted unwilling applause. The soil was sterile, acrid, alkaline, but its innate stores of fertility were brought out by persistent irrigation. Grasses and cereals were sown, and trees were planted; the excessive radiation which had dispelled the rain clouds was arrested, and the climate was soon perceptibly ameliorated. A score of years has sufficed to make "the desert blossom as the rose." Rain-fall has increased, and its preponderance over evaporation is shown by the perceptible rise in the level of Great Salt Lake, which is reliably reported at one foot per annum. The steamer now visits points hitherto inaccessible. These facts are decisive as to the operation of ameliorating causes which, it is hoped, will ultimately revolutionize the physical characters of this whole region. Its facilities of irrigation give it very great advantages over Eastern Utah.

In cereal and fruit production this Territory has already attained a remarkable eminence. Horticulture is also advancing with great rapidity. The operations of all braches of agriculture are, however, seriously annoyed by the prevalence of grasshoppers. Almost one-fourth of the crops of wheat, barley, oats, and corn, in 1868, was destroyed by the locusts. The excessive production of grasshoppers is shown by an extreme case, about two hundred larvæ being detected in a cubic inch of dirt in the vicinity of Salt Lake City. A singular method of destroying them is the excavation of ditches, into which the insects are driven by millions and buried. They are also driven into creeks, traps of gunny sacks, netting, and baskets, set for their destruction. On one small stream twenty bushels a day have been destroyed, the insects being about the size of house-flies. One farmer, having buried eighty bushels, succeeded in raising fine crops.

The fruit culture of Utah is very promising. In addition to the species imported by the Mormons from the States, several semi-tropical fruits of great richness and delicacy are grown. Apricots, pomegranates,

peaches, apples, plums, &c., seem to grow thrifty in spite of the insects. Grape culture is assuming considerable prominence, and wine-making is becoming extensive. One village last year reported four thousand gallons. The length and equability of the heated term, with the facility of regulating the application of moisture by irrigation, tend to produce a remarkably sweet and tender grape, thoroughly elaborating its juices. Silk culture is also well adapted to this region. The white mulberry thrives, and the climate, in addition to its equability, is especially free from explosive electricity.

The following data of 1868 throw light upon the recurrence of seasons at St. George, in Utah: July 15, apricots ripe; June 15, noon temperature 105° Fah. in the shade; July 7, ripe figs; July 6, wall cherries ripe; July 8, Isabella grape colors; July 8, tomatoes ripe; July 10, first ripe peach and Japan lilies in bloom; July 12, white Chasselas grapes ripe; August 1, Old Mission begins to ripen and Black Hamburg to color; October 20, pomegranates ripen.

The results already indicate an agricultural capacity in this apparently desert region which promises to render it capable of supporting a large civilized population. Manufactures have assumed considerable importance, embracing a very considerable range of industry. Three cotton mills, one woolen factory, one hundred flouring mills, and fifty lumber mills are in successful operation, besides manufactures of agricultural implements, steam machinery, furniture, &c. The extension of railroad facilities, by the completion of the initial transcontinental line, has greatly stimulated settlement in this part of the country. The hostile attitude of the Mormon community has thus far repelled the Gentile element; but internal dissension, co-operating with outside pressure, promises to undermine this hostile *imperium in imperio*, and to open this eligible region to general settlement.

Of the total area of Utah, 2,525,872 acres have been surveyed, leaving 51,539,203 unsurveyed on the 30th of June, 1869. The number of acres remaining unsold and unappropriated at that date was 48,820,427. The natural timber lands comprise about 2,000,000 acres, but large areas are every year planted in orchards or timber of some sort. Of the amount of land capable of cultivation or suited to agriculture, it would be impossible to give even an approximate estimate.

NEW MEXICO.

New Mexico, situated between the parallels 31° 20′ and 37° north, and between the meridians 103° and 109° west from Greenwich, covers an area of one hundred and twenty-one thousand two hundred and one square miles, or 77,568,640 acres, being three hundred and fifty-two miles long from north to south, with a breadth of three hundred and thirty-two miles. Its leading feature is a series of high plateaus intersected by frequent mountain ranges, and deeply creased with valleys of several important rivers.

The Rio Bravo del Norte, or, as it is commonly called, the Rio Grande, traverses the Territory from north to south, dividing it into two unequal portions. Its basin, flanked on the east and west, respectively, by the Rocky and Sierra Madre ranges, varies in breadth, being forty miles wide at the Colorado frontier, though often narrowing to a few miles in width. From Bernalillo to the limits of the Territory the average width perhaps does not exceed two or three miles of arable bottom land, generally very fertile. The following statements, chiefly taken from a pamphlet on New Mexico, by Hon. Charles P. Clever, formerly delegate from this

Territory, give, perhaps, a more correct condensed description of its outlines than can be found elsewhere.

West of the Rio Grande is a region of table-lands, called mesas, with broad valleys between them. In some cases their escarpments are so abrupt as to stand out from the landscape like Titanic fortresses. Ranges of peaks and ridges intersect this region, some of them deeply seamed with lava streams from extinct volcanoes. In the south-west a range of high mountains extends far into Arizona. The western slopes of this region give rise to the leading affluents of the great Colorado of the West. East of the Rio Grande the Territory is intersected by a number of subordinate ranges or cordilleras of the Rocky Mountain system, running in a general north and south direction; these are lost through wide spaces in the surrounding table-lands, but reappear in isolated peaks or in abbreviated sierras. From the most easterly of these ranges vast steppes, like terraces, descend gradually eastward, forming the great Llano Estacado or Staked Plains. Through these steppes, in the lapse of ages, the rivers and smaller streams have worn deep channels, and grooved out wider basins of surpassing beauty and fertility. The largest of these, the Pecos, traverses the eastern portion of the Territory and empties into the Rio Grande, in the State of Texas, below the thirtieth parallel. The north-eastern part of the Territory is drained by the Canadian and its branches into the Arkansas River.

The mountains present several lofty peaks; in the Sierra Madre range Mount Taylor rises to an altitude of sixteen thousand feet above the sea. The mountains all through the Territory are clad in forests of pine, spruce, cedar, fir, and kindred trees. The aspen is found at high elevations and in great quantities. The foot-hills and a portion of the mesas are covered with the piñon interspersed with the cedar. Along the rivers and streams the natural growth is made up principally of cotton-wood, sycamores, hackberry, willow, wild grape vines, &c. Along some of the southern water-courses oak and walnut are found in limited quantities. High up all these ranges nutritive grasses grow in great luxuriance, the low latitude largely compensating for high altitude. The mesas are covered with them, and even in the forests they have an irrepressible growth. While covered with snow at high altitudes, they are preserved in full richness, awaiting the grazing season in the spring, when they afford excellent pasture. The most abundant of the species of grass on the mesas is the *grama*, celebrated for its nutritious qualities. Instead of wilting and losing its value during cold weather, it becomes cured on the stalk, affording a very excellent support for live stock. To these superior facilities for stock-raising may be added a climate destitute of the cold storms and bleaching rains of the region farther north, and, at the same time, free from the parching heats of lower lands in the same latitude. The diseases incident to the herding of sheep and cattle in close barns and small yards during cold weather are entirely avoided by the wide range afforded by these mesas and valleys, and by driving the flocks further southward in extreme cold weather. The change of pastures secured by these temporary migrations constitutes another element of great advantage to stock-raising.

The native sheep, although affording profitable investment for capital and labor under the old Mexican régime, will soon be supplanted by imported breeds. Ample labor to meet the demands of the rude pastoral industry of the Territory is supplied by the emancipated peons at low rates. Owing to the small outlay required, sheep husbandry continues profitable under the primitive conditions still existing, notwithstanding the distance of the markets.

The quality of both mutton and wool produced is of a superior character. The wool clip of 1867 amounted to two and a half million pounds and has since increased. In San Miguel County, the best for pasturage in the Territory, about three hundred thousand sheep are owned, and during part of the year, including these, from seven hundred thousand to eight hundred thousand are pastured. The average yield of wool to the sheep is about one and a half pound washed. Average price per head, two dollars. The average weight of the carcass, net, when butchered, as ascertained by the commissary, is twenty-seven pounds. The annual increase, including ordinary losses, is seventy-five per cent.

This industry is crippled, however, by the difficulty of getting it to market, transportation costing as much as the original value of the wool. The establishment of a thorough system of home manufactures would save this enormous expense. Woolen manufacture has already been introduced into Mora county, with very satisfactory results, and it is thought that this judicious movement will assume still greater proportions. The same richness and cheapness of the elements of subsistence and care of live stock apply no less to cattle, horses, mules, and swine, than to sheep. The vast supply of beef that has been opened up to the nation by the construction of the Kansas Pacific railroad has already met a pressing public necessity. Cattle raised in Texas can be purchased at $12 to $14 per head, in currency, and in six or eight weeks driven to the railroad shipping station for $2 per head additional. Transportation to Chicago costs about $150 per car-load, affording the beef on the hoof at four cents per pound, with broad margins to all parties. The extension of this railroad along either of its projected alternative routes, or the construction of any one of the other southern lines of Pacific railway now before the public, would open up to the nation an enormous supply of animal food, and develop the resources of one of the most eligible regions on the continent. The small native breeds would soon be supplanted by fine imported stocks, and this branch of agricultural enterprise in New Mexico would assume proportions demanded by our rapid national growth. The crop-raising interests of the Territory give promise of a development no less cheering. The valleys of the rivers embrace large bodies of bottom-land immediately available for cultivation. Irrigation has added a large productive area in the hill-sides and mesas, and gives promise of a still greater extension of its beneficial influence; for, wherever the land can be irrigated, it is productive. This process dates back to the commencement of Spanish settlement in the country, and has long since been reduced to a regular system. The usual method of irrigation involves, first, the construction of a main canal or ditch, at public expense, sufficient for the wants of a local community, through the more elevated localities. From this canal, called *acequia madre*, each farmer runs a ditch of capacity suited to the extent of his farming operations. If the supply of water is limited, the allotment of each individual is regulated by public authority; each private ditch distributes its water over successive portions of the farm, enabling one person to irrigate five acres per day under favorable circumstances. On uneven ground, or with scant supply of water, of course great deductions must be made from this estimate. The necessity of irrigation, however, seems to be less imperative as the settlement of the country enlarges. The same ameliorating climatic influences which are observable in Colorado are not less operative in Northern New Mexico. The rivers are presenting larger volumes, and intermitting streams are becoming constant in the discharge of their waters. In some localities

acequias are allowed to fall into dilapidation for lack of use. As late as 1862 and 1863 the Arkansas River was dry from the Pawnee to the Cimarron crossing, but such a thing has not been known since. Seven or eight years ago the Pecos would dry up during the summer heat, but this fact is no longer observable. The Vermejo, Rayado, and other tributaries of the Canadian River have evidently been sending down larger average volumes of water during the past six or eight years than formerly. In 1868, the crops along the Rayado were injured by the rains. The same thing occurred at Piña Blanca in 1869, the rains washing the soil on the crops. But while this change is going on in parts of the Territory, the reverse appears to be the case in other sections, as the high, broken, marly tracts where the scanty cedar growth is being stripped off. It is a common expression of the Mexicans and Indians that "the Americans always bring rain." The cereals in the bottoms and on the irrigated hill-sides yield abundant crops. Corn, wheat, barley, and oats are the staples. Spring wheat is generally cultivated, for the reason that the lands are not fenced, and the snows of winter do not fall deep enough, nor lie long enough to protect the growing crops. Two kinds of wheat are reported, viz: the New Mexico wheat, a dark, small grain, and the Sonora wheat, much lighter. The former is heavier and more substantial; the latter ripens earlier, and yields a whiter flour. In the central parts of the Territory, sowing is done in March, and harvesting in July and August. To the northward the seed-time is as late as the 1st of May, and the harvest is gathered between the 25th of August and the 10th of November. Peas and beans are extensively cultivated, the crops yielding a profit of fifty per cent. with but little labor.

In the Taos Valley there are about 10,000 acres of arable land, mostly under cultivation in wheat and corn. This is probably the best wheat section in the Territory, the Moro Valley being the next best. In San Miguel County corn is the principal crop. Grapes grow well from Bernalillo southward, and many vineyards are being planted which will doubtless prove remunerative. The produce in 1867 was 40,000 gallons; in 1868 about 100,000 gallons. Several Americans, anticipating the construction of a railroad, have planted vineyards. Peaches and apples produce well, especially from Albuquerque southward. Cabbages have been raised at Santa Fé weighing fifty-six pounds, and beets at Masilla, one of which reached seventy-three pounds. Other fruits, melons, pumpkins, frijoles, and most vegetables of the Middle and Western States may be raised in parts of the Territory. The finest onions perhaps of the world are produced here, pearly white, large size, and excelling those of any other country in flavor. Sweet potatoes have been raised in the southern portion, and cotton was formerly successfully grown at Algodones. Many medicinal roots can be raised in this Territory of a better quality than in any other portion of the Union, except portions of California, the average strength in many cases being considerably above the standard of the pharmacopœia. The agricultural processes and implements in New Mexico are generally of a very rude and primitive character, a full century behind the age. The plow in general use consists of a wooden pole with a sharp iron point and a wooden handle. The drilling process of seeding is entirely unknown. Threshing is done by the tramping of horses, mules, sheep, or goats, involving a great loss of grain and straw. The governor of the Territory, in his annual message to the legislature in 1867, sharply censures the unprogressive character of New Mexican agriculture, and warmly welcomes the arrival of American settlers from the States. A large immigration had been received during that year, especially in the Rio Bonito Valley, one of the finest

in the Territory, in the Rio Charmer Valley on the northwest, and on the Mimbres river in the southeast. The depredations of wild Indians, many of them beneficiaries of the general government under treaty stipulations, have restrained settlement in some of the most desirable portions of the Territory. The annual loss to which the old Mexican population has submitted for ages from these savage freebooters, in live stock and grain, to say nothing of wholesale murders and devastations, is almost incredible. The Indians infesting these regions, especially the Apaches, Navajos, Comanches, and their kindred tribes, are the most formidable foes of civilization on the American continent. The mountainous character of the country has favored their operations, presenting retreats to which the timid Mexicans dare not follow them. The advent of American settlers in force, and the extension of our social system over this country, will soon overpower this destructive element, and secure the reign of peaceful industry; and the planting of trees and ornamenting the grounds around their homes, a thing wholly neglected and abjured by the Mexican population, will not only assist in increasing the moisture, but will give to the beautiful valleys a character thus far wholly unknown. This American immigration is increasing. Already it has introduced the higher elements of scientific agriculture. The fruits of the older portions of the country have been introduced, and the native fruits have been improved by grafting. A fine scope for the cultivation of rich semi-tropical fruits has been developed. This progressive movement is yet of small proportions but encouraging for the future. The extension of railway communications will realize the most sanguine anticipations in regard to the growth of New Mexico.

The population of the Territory is about 115,000, not including Indians. A very large portion of the soil had been granted by the Mexican government to private owners prior to the acquisition of territorial rights by our government. The terms upon which lands may be had of these proprietors vary with their necessities. In some counties scarcely any settled price can be named. If a person manifests any anxiety to purchase, he is asked an exorbitant price. If a proprietor is anxious to sell, he can command but a small proportion of the real value. Since the inauguration of our public-land system, Indian and Puebla and other private land grants have been confirmed to the extent of 2,299,674.26 acres; of which, however, only 80,985 acres have been located by public survey. The entire amount of land surveyed up to June 30, 1869, was 3,114,731.77 acres. There yet remain for disposal by the government 70,704,558 acres. There are at least 10,000,000 acres of arable land, and 50,000,000 acres of grazing land.

ARIZONA.

Arizona is about three hundred and eighty miles long from north to south, with a breadth of three hundred miles, embracing an area of one hundred and thirteen thousand nine hundred and sixteen square miles, or 72,906,240 acres. This Territory embraces the lower portion of the great basin drained by the Colorado of the West. It is subdivided by the subordinate valleys of this basin, each taking the name of an affluent of the great river. Considerable topographical information has been collected by exploration, but experience has shown that the reports of even the most careful explorers are to be received with caution, and that no very accurate general knowledge of any portion of our public domain has been acquired prior to actual occupation and settlement.

The Colorado forms the west boundary of the Territory from the point where it crosses the one hundred and fourteenth meridian to its

confluence with the Gila. This great river, sometimes called the Mississippi of the West, is over twelve hundred miles long, and drains three hundred thousand square miles. The upper portion of this basin, divided between Colorado and Utah, will be found described in the articles on those Territories. A remarkable feature of this upper region—the depth of its water courses below the general land surface, precluding irrigation—is not observable in the lower valley. It has long been suggested in official circles that the Colorado is destined to reproduce on the American continent the historic rôle of the Nile in Egypt. It is subject to an annual overflow from the melting snows of the mountain ranges which flank its entire valley, with an average elevation of several thousand feet above sea level. These overflows cover the immediate valley of the river, or perhaps a million acres. The topography of the lower valley is favorable to the construction of irrigating canals, by which this immense surplus of water, rising from twenty-five to forty feet above the ordinary level, may be utilized on a grand scale.

The celebrated Colorado Desert, bordering this river for one hundred and fifty miles, is several feet below its bed, and possesses a soil composed of alluvial earths, marls, shells, &c., needing only the stimulus of moisture, co-operating with its high temperature, to awaken a very great fertility. There is no reason why the application of irrigating waters to this barren surface may not make it the rival of ancient Egypt, which in the time of the caliphs was called the Granary of the East, and supported a population of twenty million souls, besides exporting grain to all the surrounding countries. The Colorado soil is of equal richness, while its climate is still more genial to all the operations of husbandry.

The Colorado Valley was the theater of early Spanish colonial enterprise. Along the Santa Cruz, a tributary of the Gila, an agricultural and mining population had established itself in the beginning of the eighteenth century, and flourishing settlements were planted in the main valley of the Gila and along its tributaries, the Salinas and the Rio Verde. The relics of this former civilization are still found. The ruins of a network of irrigating canals show that agriculture was prosecuted on an extensive and intelligent scale. Churches, cities, and plantations now in ruins speak of an advanced social organization, which has perished through the sullen hostility of the Mohaves and Apaches, or through the persecution of the revolutionary governments of Mexico. This great valley is not, then, virgin soil for Anglo-Saxon civilization.

Its most northern affluent in the Territory, the Colorado Chiquito, or Little Colorado, rising in the Sierra Madre, in New Mexico, sweeps through Northern Arizona in a wide curve of 400 miles, penetrating several minor ranges of mountains with intervening plateaus and rich bottom lands. It offers, to a considerable extent, the same facilities for irrigation which characterize the parent stream. Extensive belts of timber cover the mountains and hills, and large areas of woodland diversify the great upland plains. Very considerable tracts of rich bottom lands are found along the the various streams. All the reliable indications drawn from reports of explorations point to the capacity of this region to support a large agricultural population, either by crop-raising or by stock-raising.

Bill Williams's Fork, next southward of the Colorado Chiquito, rising in the Aquarius Mountains, flows south-westerly into the Colorado, receiving several minor affluents. The valleys of these streams are reported, on good authority, as well adapted to cultivation, while the

neighboring uplands are excellent for grazing. The most prominent of these minor valleys is the Rio Santa Maria. This whole basin is of minor extent as compared with the Colorado Chiquito, but it is of equal value as an agricultural region.

The Gila and its affluents constitute an extensive river system. This stream rises in New Mexico, flows across the southern part of the Territory, and empties into the Colorado opposite the south-east corner of the State of California. Its southern branches are the Rio Santa Cruz, Rio San Pedro, and Rio San Domingo. On the north side the most prominent tributaries are the Rio Verde, or San Francisco, the San Carlos, and Rio de los Palos. The valley of the San Pedro, over one hundred miles in length, expands in many places to a wide expanse of excellent arable land. Its minor tributaries extend this agricultural area very considerably, giving scope for an extensive agricultural settlement. From the mouth of its affluent, the Arrowapa, to its junction with the Gila, extends a beautiful, fertile, and well-wooded region, which will probably attract an extensive immigration as soon as the present Indian difficulties are settled. The Santa Cruz Valley is wider than that of the San Pedro, and equally rich and well timbered. Both these valleys are supplied with running waters, nutritious grama and mesquite grasses, green and growing at all seasons. The Santa Cruz region was occupied by Spanish Jesuit missionaries as early as the year 1600, the ruins of whose ecclesiastical and agricultural establishments are still traced. The church of San Xavier del Bac attests, even in its dilapidation, a wealth, refinement, and religious public spirit which argue a very productive industrial system, and a healthy social order.

When the power for mischief now wielded by untamable savages shall have been neutralized and subverted by a sufficient reinforcement of civilized population, these desert areas will blossom as the rose. The lazy Yumas and Mohaves, taking advantage of the annual overflows of the streams, with very little labor and by very rude processes of culture, secure a subsistence. The main portion of the American population is located in the central parts of the Territory along the water-courses. The character of pioneer agriculture is well known for its wasteful processes, and its lack of skill as compared with the scientific farming of the older States. This characteristic is not wanting in the essays already made in the cultivation of the soil of Arizona. Yet, from these ill-directed and imperfect attempts, very encouraging results have already been realized. Governor Safford states that the yield of corn averages from thirty to sixty bushels per acre; and that, in an instance of superior cultivation, one hundred and five bushels per acre were realized. Very little care, he states, is taken in preparing the soil for the seed, or in the subsequent operations of culture. Wheat, barley, and oats, vary from forty to sixty bushels per acre, while the vegetables grow in quantity and quality unsurpassed in any part of our country. The orange, lemon, olive, grape, and fig yield abundantly, while in the uplands the apple and peach do equally well. In some parts of the Territory the soil yields two crops per annum without any perceptible diminution of its productive power. One farm near Tucson has been in cultivation for near one hundred years, producing two crops per annum, and yields to-day as great a crop as ever, without manuring.

Estimates given by the Commissioner of the General Land Office, in his report for 1868, exhibit 5,000,000 acres of the Territory susceptible of irrigation, and 55,000,000 acres grazing lands; the remaining 12,906,240 acres, with the exception of portions covered by permanent bodies of water, consisting of inarable plains and rough and broken mountains.

The supplies of timber are extensive, while large deposits of mineral coal are reported in different localities. The climate is warm, but so tempered by ocean breezes as not to be oppressive.

Of the public lands there have been surveyed, up to June 30, 1869, 686,028 acres. The amount unsold and unappropriated at that date was 68,855,890 acres. The southern transcontinental railway routes all pass through Arizona.

The progressive impulses of civilization will sooner or later compel the completion of one or more of these lines. In this case the extension of settlements will destroy the hostile power of the savage tribes and open up one of the fairest portions of our public domain.

NOTES FROM RECENT FRENCH PUBLICATIONS.

The following notes from official and other publications relating to agriculture, issued recently in France, are brief digests of the reports and papers, and the opinions presented are not necessarily adopted or commended by this Department. The intention has been to indicate the spirit and tenor of the original, and to widen the field of agricultural inquiry by opening new and foreign views, dissimilar in some cases in tone and color from those to which we have been accustomed. As American agriculture acquires enlargement and intellectual elevation, its field of observation and comparison will embrace the civilized world, and the scientific deductions and experimental data of all nations will be appropriated to its use. The foreign exchanges of the Department will hereafter add much to its stores in this direction.

THE AGRICULTURAL CONGRESS IN PARIS.

The Revue des Deux Mondes gives a synopsis of the proceedings of a congress of agricultural and industrial delegates from all parts of France, held in Paris in December, 1868. The first business of the body was the formation of a National Agricultural Society.

This society has just published its first annual report, and shows among its members and officers the most distinguished agriculturists of the country. Its president, M. Drouyn de l'Huys, late minister of foreign affairs, writes the preface of the work. The great aim in the establishment of this society, as stated by its distinguished president, is to unite in one organization all the agricultural interests, to give them more force, and teach them the habit of defending themselves. This is the greatest effort that has yet been made in this direction in France.

At the meeting on the 16th of December more than eighty agricultural societies of the provinces sent delegates. After organization came discussion. The society, in the order of its work, divided itself into ten sections. The work had been prepared in advance, and was submitted by each section to general vote.

The first section, on agriculture proper, made two reports, one on manure, the other on steam labor. The assembly passed a measure without discussion praying for the abolition of all tariff on fertilizing matter, and for a reduction of the railway charges of transportation of the same; and also provided a prize for the best essay for utilizing what is called human manure for farming purposes. The report on steam labor proposed to establish, at the expense of the society, a public competition of machines for labor.

The second section, on cattle economy, was first occupied with the

contagious typhus of horned cattle, which has recently committed such ravages in neighboring countries. The assembly approved the means of protection employed by the government in pursuance of the law of 1866, especially in that feature which accords three-quarters of the value to the proprietors for animals slaughtered for public utility. A proposition to have a public exhibition at Paris, in 1870, of the males of all kinds of domestic animals provoked lively discussion, and was referred to a committee.

The third section, on vine-culture and wine-making, was chiefly occupied with local tariffs.

The fourth section was devoted to forest-culture.

The fifth, seventh, and eighth sections did not have sufficient time to make out reports.

The ninth section, on rural economy and legislation, presented seven reports on subjects either of local interest only or containing nothing especially new.

The tenth section, on agricultural instruction, offered resolutions in favor of the re-establishment of the ancient National Agricultural Institute, for an increase of schools, for the creation of a farm school, allowing participation in the profits to the students, and for the development of agricultural orphan schools.

RATIONS ACCORDING TO WEIGHT OF DIFFERENT ANIMALS.

The Société Impériale et Centrale publishes an article on the quantity of rations which should be given to animals according to their live weight. They are divided into the keeping, the growing, the fattening, and the mother ration; the latter being destined to furnish milk to the young. The ordinary, or keeping ration, varies according to the requirements of each organization, but much more according to size and weight. In general the ration should increase in proportion as the animal diminishes in size. In birds and mammiferous animals the animal heat must oscillate between thirty-six and forty-two degrees centigrade, in order that all the phenomena of vitality may occur with regularity. This heat is produced immediately and only by combustion of the hydrocarbonic matter with the inhaled oxygen; and the aptitude of heated bodies to cool the temperature of the outside air is in inverse proportion to their volume or size, the caloric escaping more rapidly in proportion as the body is small. Under these conditions the consumption of food must be increased as the size of the animals decreases. Numerous experiments have shown that a cow of the weight of 750 to 800 kilograms is sufficiently fed when she secures a ration of hay of two and a half per cent. of her live weight. From calculation it is found that a table of the percentage of food required for different animals may be established as follows:

3 per cent. of live weight for a cow weighing 350 kilograms.
4 per cent. of live weight for a cow weighing 200 kilograms.
3 per cent. of live weight for a horse weighing 450 kilograms.
4 per cent. of live weight for a hog weighing 100 kilograms.
5 per cent. of live weight for a hog weighing 60 kilograms.
8 per cent. of live weight for a rabbit weighing 3.500 kilograms.
9.7 per cent. of live weight for a turkey weighing 3.750 kilograms.
9.6 per cent. of live weight for a duck weighing 1.940 kilogram.
12 per cent. of live weight for a chicken weighing 1.750 kilogram.
12 per cent. of live weight for a guinea pig weighing .700 kilogram.
16 per cent. of live weight for a pigeon weighing .460 kilogram.
24 per cent. of live weight for a dove weighing .159 kilogram.
60 per cent. of live weight for a mouse weighing .015 kilogram.
65 per cent. of live weight for a sparrow weighing .016 kilogram.

When the temperature falls the animal loses much caloric, which it makes up by additional eating; hence the requirements in the way of food are greater in winter than in summer.

Carbon and sometimes a certain quantity of hydrogen are burnt every instant in the animal organism, to be converted into carbonic acid and water. They are exactly like the wood consumed in the fire-place. The poetic assimilation of the locomotive with the animal is happy; in each there are three phenomena, combustion, heat, and movement, united and proportional.

To ascend to the top of Mount Blanc a man employs two days and a half; during this time he burns 300 grams of carbon or its equivalent of hydrogen. If a steam-engine carried him, of the exact power necessary, it would burn 1,000 to 1,200 in taking him there. Thus as a machine, deriving his force from the carbon which he burns, man is a machine three or four times more effective than the steam machine.

Science has shown that a man of ordinary size, working moderately, exhales in twenty-four hours in the form of carbonic acid 435 grams of carbon, burnt in his organs by the atmospheric oxygen furnished in breathing. But it varies, of course, greatly if the man remains in repose or works hard.

When work is to be done by animals the force expended can be made up only by food rich in respiratory carbon and assimilable azote. The consecutive phenomena of digestion and respiration are the same in animals as in man, and when the proportion of carbon and hydrogen, or their equivalents, which they use in twenty-four hours, is ascertained, the quantity of their ration may be determined. To this end the following table is prepared:

Animals.	Weight of animals.	Elements burnt and rejected. Carbon.	Hydrogen.	Nitrogen.	Carbon and hydrogen, estimated in carbon.
	Kilogs.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Horse	500	2,465	25	23	2,615
Cow	550	2,211	20	27	2,331
Hog	60	661	3	4.5	679
Sheep	20	154	3	1.3	154

If the figures of the last column, representing the hydro-carbonic aliments consumed by the animals, are converted into their equivalent in hay, and starting from the fact that every kilogram of hay submitted to the work of digestion brings to its action 222 gr. of respiratory carbon, it is found that the horse requires for his keeping 11.740 kilograms of this forage, the cow 10.460 kilograms, the hog 3 kilograms, and the sheep 691 grams.

If these quantities are put in regard to the weight of the animals, and proportional relations established between them, the following results are arrived at:

The horse of 500 kilograms requires 11.740 kilograms of hay, or 2.35 per cent. of his weight.

The cow of 550 kilograms requires 10.460 kilograms of hay, or 1.92 per cent. of her weight.

The hog of 60 kilograms requires 3 kilograms of hay, (or equivalent,) or 5 per cent. of his weight.

The sheep of 20 kilograms requires .961 kilogram of hay, or 3.46 per cent. of its weight.

The sheep here appears to be an exception to the rule laid down—the smaller the animal the higher the percentage; but this anomaly is explained by the fact that the animal is covered with thick, close wool, which preserves it from the cold without, whence the double consequence of less carbon and a diminished ration.

HOGS IN FRANCE AND GREAT BRITAIN.

According to M. Gayot, of the Société Impériale et Centrale d'Agriculture de France, there are three porcine races: the Asiatic, Neapolitan, and Celtic, the first two being foreign and the latter the native race in France. The foreign races have earlier development, and are more easily fattened than the Celtic. In a good portion of France the Celtic is still the dominant race, but in Great Britain it has almost disappeared through perpetual crossing. The English wanted a certain kind of a pig, and they have produced him just as they have produced the race-horse. Quickly grown and quickly fatted is their rule. All their energies have tended this way, and they have succeeded naturally in forming great balls of grease, which bear off the honors at agricultural fairs.

M. Gayot thinks the fat pig of England is a mistake, and is sorry to see his countrymen seduced into raising such stock. In France the consumer of pork desires the lean part to be as good as the fat, even if it does take a little longer and costs a little more to produce it. In England they have occupied themselves exclusively in raising fat in abundance, without regard to the quality. What they call their perfection is a mischievous exaggeration. The Frenchman likes the firm and savory fat of his pure Celtic pork, and not the oily, soft, melting fat of the English. In many parts of France beef and mutton are beyond his means, and pork is his only meat; hence it is important that this should be of the best quality. He can only get this from his own race, which has fat and lean in healthy proportions. The slower growth of the Celtic makes the fiber of the flesh fine and compact, and when this is well formed the fat solidly develops itself as a natural result of health. Meat of this kind is nourishing.

The fatness of the English race is abnormal, and bears in its soft, unformed fiber and grease the seeds of disease. Its precocity and capacity for fattening are pushed to such extremes that, as an article of food, it should not be thought of. If the object is to make lard, hogs of this race may be raised for a few generations; but bred in and in they in time run out, for when animals become extraordinarily fat they lose their generating power. This failure to procreate, by an unerring law of nature, shows them to be imperfectly constituted, unhealthy, and consequently unfit for consumption.

In a word, M. Gayot speaks with enthusiasm of the Celtic race of pigs, and strongly counsels his countrymen to banish the English importation.

HORSE MEAT.

M. Duroix states that in July, 1866, horse meat was allowed to be sold publicly in Paris. Six months after this, its official introduction, not more than a dozen horses were slaughtered each week. At the present time about eighty are killed every week, and about fourteen butcher-shops are engaged exclusively in its sale in the capital. From investi-

gations made by the authorities, the horse yields a percentage of meat to his live weight of 65 to 70, which is more than that obtained from the ox. The price of the meat varies according to the pieces—tenderloin, one franc per pound; and pieces of the neck and breast, five sous the pound.

There are also in Paris four restaurants of horse meat, and five establishments where sausage is made from horse flesh, and sold at half the price of other sausage.

The provinces are beginning to follow the example of Paris in slaughtering and selling horse meat. There is much less prejudice against its consumption than formerly.

The horses slaughtered are generally old and worn out in their extremities, but free from internal disease. When reasonably fat the meat is sold in pieces like beef; when not fat it is used for sausages. When very thin the meat is not offered for sale in any form. The authorities exercise vigilant supervision over the meat as regards quality and wholesomeness.

PROGRESS OF ACCLIMATION IN AUSTRALIA.

From the Bulletin de la Société d'Acclimatation it appears that the goats of Angora, introduced under the auspices of the Society of Acclimation of Victoria into Australia, have prospered and multiplied. Before long their fine wool will constitute an important article of exportation. The common honey-bee was introduced only a few years back, and now considerable quantities of honey and wax are produced in divers districts. The mulberry plantations have recently been extended, and with them the number of silk-worms increased, so that silk promises soon to be a commercial product. The camel has also been installed in the colony, and his complete adaptation to the climate of Australia is now demonstrated. As a means of transport this animal will be invaluable in the arid and sandy districts of the interior.

IMPORTATION OF EGGS IN ENGLAND.

From 1843 to 1847 an average of 73,000,000 of eggs per annum was imported into England. In the following five years the average rose to 103,000,000, then to 147,000,000, and afterwards to 163,000,000. In 1861 it reached 203,000,000; in 1864, 335,000,000; and in 1866, 438,000,000. It is probably at present one and a half millions per day. France alone furnishes more than eleven times as many as all other countries put together. The value of the entire importation of eggs into England is estimated at $10,000,000 per annum. The rapid increase is owing chiefly to the great facility of communication.

PRESERVATION OF EGGS.

To have eggs always fresh is naturally much to be desired. Several modes of preservation have been attempted, but with imperfect success. Continued immersion in lime-water gives the egg a peculiar taste not agreeable. Some advise salt water, but it penetrates the egg. Ashes, bran, and sawdust do not preserve it. Varnishing has been practiced, but abandoned on account of the odor and taste which it communicates when anything else than oil is employed. The following experiments with pure oil have been made:

Ten eggs were rubbed with the finger dipped in flaxseed oil; they were thus enveloped in a very light oily coating, which dried in a few days. Ten other eggs were oiled in the same manner, but with the oil of the French poppy, to ascertain the comparative effect of the two oils.

Two eggs were not oiled and received no preparation. The twenty-two eggs were placed side by side, but not in contact, in a vessel the bottom of which was covered with a bed of sand sufficient to keep them standing upright—three-fourths of each egg being exposed. They remained thus in a laboratory during six months, and during this period were weighed three times, the first at the beginning of the experiment, the 1st of August, the second after three months, the third at the end of six months.

The following table shows the different weighings:

Eggs rubbed with flax-seed oil.

	Grains.	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
Primitive weight	45.80	52.50	50	64.90	49.90	54.70	49.30	52.90	54.80
Weight after 3 months	45	51.80	48.60	63.20	48.50	53.50	48.60	51.80	53.80
Weight after 6 months	44.50	51.40	48	62.40	48.40	52.90	48.30	51.30	53.40

Eggs rubbed with oil of poppy.

	Grains.	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
Primitive weight	48.50	50	49.10	53.40	53.40	46.50	52.50	54.90	46.90	54.30
Weight after 3 mos.	46.70	48.60	47.20	52.50	52.10	47.70	50.60	54	46	52.70
Weight after 6 mos.	45.90	47.70	46.30	52.10	51.40	43.90	48.70	53.60	45.50	51.80

Eggs not prepared.

	Grains.	*Grains.*
Primitive weight	52.80	57.30
Weight after 3 months	46.60	51
Weight after 6 months	43.10	47.10

From which may be drawn the following conclusions:

1. The egg not prepared lost, after six months, 18.10 per cent. of its primitive weight, was half empty, and exhaled an odor of corruption.

2. The egg rubbed with oil of poppy lost, after six months, 4.51 per cent. of its primitive weight, when it was found full, without odor or bad taste.

3. The egg rubbed with flax-seed oil lost, after six months, of its primitive weight, 3.02 per cent., when it was full, and had the odor and taste of an egg perfectly fresh.

Hence flax-seed oil may be deemed preferable for preserving eggs.

BRIE CHEESE.

The cheese of Brie, taking its name from the part of France where it is made, was awarded the palm of superiority over all other cheese at the great exposition, by a committee of persons of different nationalities. It is understood that the Stilton of England was next in favor. Brie cheese is made in the following manner:

As soon as the milk is drawn from the cow it is poured through a fine silk sieve, and is carried to the dairy, where it is emptied into an earthen crock; afterward a small piece of veal is put in to coagulate it, and it is allowed to remain. In this way it thickens in a couple of hours, when its temperature goes from thirty to forty degrees. Then it is drained off on willow wood into a cylindrical mold of wood, until entirely separated from the watery part, which occurs in a few days. Next it is salted and taken out of the cellar and exposed to the fresh air at a temperature of fifteen to twenty degrees. There it is turned at least every two or three days and the upper side carefully salted. When it is well impregnated with salt, and is dry, it is taken back to the cellar and deposited on a bed of

hay, where it is still turned from time to time until ready for use. Amateurs consider it made when it begins to be soft and has a strong odor. It resembles an immense pancake with a rough exterior that does not look altogether clean, but this is scraped off in eating. This cheese has a most delicate flavor and is renowned throughout Europe, and, besides this, has the advantage of cheapness. One of the most important features in making this or any other cheese is to separate carefully and entirely the coagulated from the watery part. It is considered well to press slowly and progressively, to arrive at this result, because the watery part in souring more and more as it remains, experiences a fermentation, and imparts to the cheese a taste too strong and an odor too penetrating. The atmosphere exercises a great influence in the production of this cheese, as well as the grass on which the cows are fed. The Brie differs in one important respect from most other things—it is the best cheese and the cheapest. It is within the reach of any French peasant in the district where it is made, however poor he may be, and is one of the most nutritious substances he can eat.

DAMAGE DONE BY WORMS.

M. Hecquet d'Orval publishes an estimate of damage done to crops by the white worm larva of the *Melolontha vulgaris* and the gray worm of the *Agrotis segetum*, in the province of Picardy. He estimates the loss on the average crops as follows: Thirty-three to fifty per cent. on cereals; twenty-five to fifty on pastures and forage plants; forty-nine to fifty on potatoes and beets; twenty-seven on Jerusalem artichokes.

From this statement is deduced the conclusion of a general loss of forty per cent. on all crops in this part of France. The rigors of winter will not kill these worms, as many suppose, and no means of stopping their ravages has yet been discovered.

THE ARTICHOKE.

This vegetable is rarely seen on the American table, but is largely consumed in every part of France. It is boiled and eaten by dipping into a sauce each piece as it is consumed. Sometimes the sauce is prepared in the kitchen, but more generally each one makes his own sauce at table, consisting of olive oil mixed with a trifle of vinegar and salt. Only the whitish part of the artichoke is eaten. It is nutritious, of a delicate flavor, and is more easily preserved from disease than the potato, in consequence of which one of the members of the Central Imperial Society of Paris recommends its substitution for that popular vegetable, at least to a certain extent. The same authority states that it is nourishing as well as economical food for animals.

CONDITION OF SILK CULTURE IN FRANCE.

Guérin Méneville has published a book on this subject, of which the following is a brief conclusion:

Although the cause of the malady of the silk-worms cannot be shown as a chemist would show a new substance, it may be said from numerous facts observed by men of science and practical men, that the following results are recognized: 1. That the seasons having been irregular for some time back, the health of the mulberry trees, as well as other kinds of vegetation, has been seriously influenced to an extent sufficient to affect the food of the worms, and thereby bring about the present malady. 2. That the disorders now observed in the silk-worms, and especially the corpuscles, are not the cause of their malady, but a result of their morbid condition.

M. Méneville thinks that the measure adopted by the minister of agriculture is good, viz: to encourage in localities not, or but little, infected, a regeneration of the French races for seed.

The wants of the silk producers at Lyons, however, are too urgent to wait for the

expected amelioration, and a large quantity of eggs are now already on their way from California to that city.

NEW IMPETUS TO SILK CULTURE IN ITALY.

The Italian government, desiring to give new encouragement to silk culture, one of the most important productions of the country, had silk-worm exhibitions during the month of November, 1869, in the cities of Bologna, Florence, Milan, Naples, Palermo, and Turin, where the agricultural committees were charged with the duty of examining and reporting the result of competition, and progress of the art of silk culture.

FRENCH WINE.

Dr. Jules Guyot, an authority in wines and vineyards, writes that, at the present time, the grape vine covers 2,500,000 hectares of ground in France—about the twentieth part of French territory, and the sixteenth of cultivated soil. Its raw product rises to more than fifteen hundred millions of francs per annum, (about $300,000,000 in gold;) it supports six millions of cultivators, and nearly two millions of tradesmen, manufacturers, transporters, and merchants, representing, in totality, in the production and consumption, at least twenty thousand millions of francs.

The vine is cultivated in seventy-nine departments, from that of the Gironde, which has more than 150,000 hectares, to the department of the Ille-et-Vilaine, which possesses but 104 hectares. In forty-eight departments the vine produces not less than one-quarter of the total agricultural revenue, and keeps more than a fifth of the population; in sixty-nine it plays an important part in agriculture, and in the seventy-nine departments its products are three to six times greater than those of all the other products. Everywhere it doubles the revenue of the domains, great or small, where its cultivation enters for a fifth of the superficies.

The cultivation of the vine is the simplest, easiest, and most remunerative of agricultural productions; it gives its remunerative products at the third year; is adapted to any geological formation; prospers in the most arid of soils, where cereals, roots, and forage are least likely to grow. In spite of the profits of the vine, public instruction in vine-growing and wine-making—objects of the attention, works, and publications of some eminent men of every age and country, objects of solicitude to some monks and a few sovereigns—has never been comprised in the official course of study, even in France, where the vine and its products constitute the fifth of the private and public wealth, and provide one of the largest revenues of the state. Hence are seen practices the most strange, and opposed to each other, which seem to conflict in many ways, to which is applied no rule, principle, or light which unites and permits them to be compared and appreciated. Each province, department, canton, is convinced that its respective traditional culture of the vine is the best; that it constitutes the last word on the art and science of vine culture; and each vine-dresser is persuaded that the vine cannot be cultivated and the wine made otherwise than he does it; hence the good processes of one portion are without advantage to the other, and there is an absence of logical progress. Still, in almost any group of ten vine-dressers, at least one will be found who employs a good process, but that one process is more or less neutralized in its good effects by the other nine. Latterly an attempt has been made to remedy this state of things. Dr. Jules Guyot, under the auspices of the minister of agriculture, has been making studies and embodying the same in reports,

in the seventy-nine departments where the wine-vine is cultivated in France, the same having been submitted to the minister of agriculture for correction before being collected and published in a large work of three volumes, of which the first has just been issued. This will doubtless be the best and most exhaustive work ever printed on this subject.

MANURE FROM BONES.

Doctor Hodges describes his plan as follows: Place the bones, broken as small as they conveniently can be, in a tub or trough, and throw over them about a third of their weight of boiling water, so that all may be watered; then add sulphuric acid and vitriol in the proportion of another third of the weight of the bones; mix well with a pick or other instrument, and allow the whole to remain for several weeks. If desired, this manure may be mixed with peat or saw-dust, but in this case lime must be added. In following these instructions with care, the farmer will obtain a manure of great fertilizing power. An analysis of bones manipulated in this way shows a great quantity of soluble phosphate.

DELETERIOUS EFFECTS OF COFFEE WITH MILK.

According to the Société Impériale et Centrale d'Agriculture de France, coffee is an excellent aliment which suits most ages, temperaments, and constitutions, and of easy digestion when its consumer is in good health; it is also known that black coffee is a stimulant and tonic whose intervention is advantageous after a repast to facilitate digestion.

Milk is undeniably wholesome and nutritious. Milk and coffee taken separately, not to interfere with each other in the stomach, are excellent; but, what is remarkable, when mixed and taken together they constitute a new composition which is absolutely indigestible.

This requires an explanation: The skin of animals is a nitrogenous matter which by boiling becomes a digestible product; if it be put in a fresh condition in contact with tannin it is converted into leather, when it may no longer be turned into alimentary aliment; no amount of boiling will do it. Gelatinous substances, put in contact with the tannin, are affected like the skin; they unite with it and acquire the property of resisting the effect of the gastric juice.

Now the infusion of coffee is rich in tannin, hence its mixture with milk has the immediate result of transforming the caseous part and the albumen that it contains into a kind of leather, undecomposable and indigestible, like that made in a tan pit. The composition thus produced remains in the stomach until new aliments come to displace and force it through the lower orifice of the stomach into the intestines. The sugar and bread with which this mixture is charged digest all the same, as well as the gelatinous substances, if the coffee is not used in such quantity as to render them inert.

The stomach is thus ballasted with a kind of thin milk, in which the gastric juice that it secretes constantly is quickly diluted in weakening its stimulating action on the membranes from which it comes, and the result is that the want of food makes itself more slowly felt; for this want, in general, is only developed when the stomach is empty. The consumer is thus deceived by the feeling of his stomach.

The use of this mixture is sometimes attended with disagreeable results. Those who are not accustomed to it frequently undergo a purging through indigestion, and those who are, often eventually have inflammation of the stomach or one of the maladies to which this organ is subject under the abuse thus put upon it. Women especially, from their delicate organization, suffer in the consumption of coffee with

milk. To dissuade them from its use it would be well to make them understand that *café au lait* is nothing in reality but *leather soup*.

DECAY OF ORANGE AND LEMON TREES IN ITALY.

In Europe and Asia, for twenty years back, vegetation has been subject to a diseased condition, which appears to be a prevalent invasion of plants of the most dissimilar character. Its first manifestation was amongst the hot-house vines of England. An analogous malady afterwards appeared in the potatoes, and its ravages were widespread. In the south of Europe the mulberry trees fail to nourish the silk worms. The fruit trees of France, even in the orchards of Normandy, are under the ban.

The Chevalier Giacomo Sacchero publishes a pamphlet, in which he gives an account of the disease among the orange and lemon trees of Italy. He has seen its birth in Sicily and its spread through Italy, and followed it in all its phases. After having already diminished the production of the fruit, he fears that it will kill all the trees, and he makes an appeal to his countrymen to stir them to some measure of prevention. He affirms that nothing is changed in the air or earth; the climate of Italy remains the same; the average temperature has not varied; the culture, care, and modes of reproduction are identical, and yet the orange and lemon trees are dying year by year. He believes if their vital forces are not raised up again they will all droop and disappear.

According to Mr. Sacchero the apparent causes of this disease come from a great perturbation of the ambient temperature and the alteration of the nourishing juices, which enfeeble more and more the vital resistance of these trees. He finds no remedy for the cause of this disease. He believes the trees are old and degenerated for want of renewal from their original country. Their introduction goes back several ages, and the mode of reproduction, always the same, naturally leads to age and decrepitude. The same phenomena are observed in several countries of Europe.

Mr. Sacchero avers that the only way out of the difficulty is to go to the cradle-ground of the trees in the Orient, and transport and plant a new stock of them, as the climate and mode of reproduction in his own country cannot be changed. His theory may be correct, but the experiments already made of this character by those who brought potatoes from Peru, and by the Horticultural Society of Paris, which brought, at great expense, apricot trees from Syria, do not strengthen it. The Peruvian potatoes became as badly diseased as the native roots, and the apricot trees did not flourish. It is possible, however, that another experiment in this direction may prove more fortunate. Men of progress are unwilling to admit that they are ignorant on any subject. The cause of the general disease among the trees, in spite of what has been written, has so far baffled public inquiry.

DONATIONS TO THE AGRICULTURAL MUSEUM.

Name.	Residence.	Article.
Abeel, J. H	New York City	Turkish tobacco.
American Fiber Co	do	Paper from steam-blown fiber of cane, bamboo, flax, and hemp.
Anderson, William	Washington, D. C	Corn.
Army Medical Museum	do	Substances used as food or medicine by North American Indians; insects and other specimens of natural history.
Arny, W. F. M	Abiquin, N. Mex	Graded wools; Indian woolen blanket; minerals, &c.
Atwood, G. W	St. Augustine, Fla	Semi-tropical fruits of Florida.
Baird, Professor	Smithsonian Institution	Large maize from Peru.
Baker, J. A	Washington, D. C	Collection of fertilizers.
Barnes, Almont	do	Piece of original Stuyvesant pear tree planted in 1650.
Barron, T. H	do	Duchesse d'Angoulême Pears, 3.
Barrian, Mrs	North Andover, Mass	Fruit of chamœrops infested by insects.
Berthaud, E. S	Golden City, Col. Ter	Paper from yucca and from oat straw.
Brannigan, Felix		Peat prepared for fuel, from county of Tyrone, Ireland.
Brummell, Joseph H	Washington, D. C	Specimens of corn and seed of trapa, &c.
Bryant, John Y	Baltimore, Md	Ramie fiber, (two samples.)
Bury, Anna M	District of Columbia	Eggs of mallard duck, (from dark green to pure white, laid by same fowl.)
Carstens, E	Washington, D. C	Skin of Madagascar rabbit.
Capron, Hon. Horace	do	Specimens of wood found in the earth seventy-five feet below the surface.
Chamberlain, Col. S. E	Waterford, Loudon Co., Va	Two varieties of corn.
Cook, A. C	Des Moines, Iowa	Abutilon fiber.
Davis, W. K	Louisburgh, N. C	Corn stalk fourteen feet long, six inches in circumference.
Deming, Israel	Washington, D. C	Cane sugars, (eleven samples.)
Dennet, Charles F	Boulogne, France	Ramie, raw and manufactured, China grass, hemp, jute, and flax fiber, (foreign.)
Dodge, Allen	Georgetown, D. C	Albino robin.
Dodge, Charles R	Washington, D. C	Ohio maple sugar.
Duffer, A. J	———, Oregon	Samples of Oregon wheat.
Duke, Mrs	Washington, D. C	Fruit.
Drexler, Mrs. T	do	Eight birds mounted.
Earle, E. J	Evergreen, S. C	Red wheat.
Estes, Dr. D. C	Lake City, Minn	Minerals, sand balls, &c.
Evans, A. M	Washington, D. C	Sorghum molasses.
Fitch, Captain	U. S. Steamer Marblehead	Specimens of natural history, bird and other skins, vegetable products, insects, &c.
Florer, T. W	Lauderdale Co., Miss	One bird skin.
Forman, Dr	Washington, D. C	Specimens of cotton from New Mexico.
Gibbs, Oliver	do	Hyslop crab-apples and Rio Grande wheat from Lake City, Minnesota.
Gilman, Z. D	do	Specimens of aniline colors, paraffine, carbolic acid, and other products of petroleum.
Glover, Professor T	do	Skins of (yellow) reed bird and Bonaparte gull; collection of insects, etc., etc.
Gold, T. S	West Cornwall, Conn	Specimens of corn.
Grosh, A. B	Washington, D. C	Pound apples raised by Dr. Beshel, Lancaster County. Pa.
Guillermot	Philadelphia, Pa	Cocoons of silk worm, (*Bombyx mori.*)
Haas, Henry	Depauville, Ky	Silk spun by larvæ of bee moth; clay cells of wasp.
Hamilton, G	New York City	Collection of cotton.
Hasler, T. C	Cape Vincent, N. Y	Snake and white weasel skins.
Heaton, J. C	Port Lavacca, Tex	Texan (tree) flowers, samples of cotton, and horned toad.
Hill, F. R		White wheat.
Hitz, J	Washington, D. C	Loudon pippins.
Illinois Central Railroad	Illinois	Three samples white wheat.
Irvine, Clark	Oregon, Mo	Western grasshoppers.
Jackson, W. F	Jetersville, Va	Samples of wheat.
Johnson, W. W	Helena, M. T	Specimens of insects.
Kansas State Agricultural Society.		Fruit, vegetables, and grain, from State fair of 1869.
Keffer, J. C	Montgomery, Ala	Insects.
Kennedy, Jos	Washington, D. C	Mixed corn.
Kingsland, George	Rutherford Park, N. J	Samples of sweet corn.
Laflin, Hon. A. H		Esparto grass, and paper made from it.
Leach, H. E	Washington, D. C	Samples of red corn.
Lewis, William T	Louisville, Miss	Sample of oats grown spontaneously; snake skin, &c.
Lincecum, Dr. G	Long Point, Texas	Insects from Mexico and Texas.
Little, J. S.	Rei, Ripley County, Ind	Insects, (*cantharis.*)
Maine Board of Agriculture.		Sample of Arnautka spring wheat.

Donations to the Agricultural Museum—Continued.

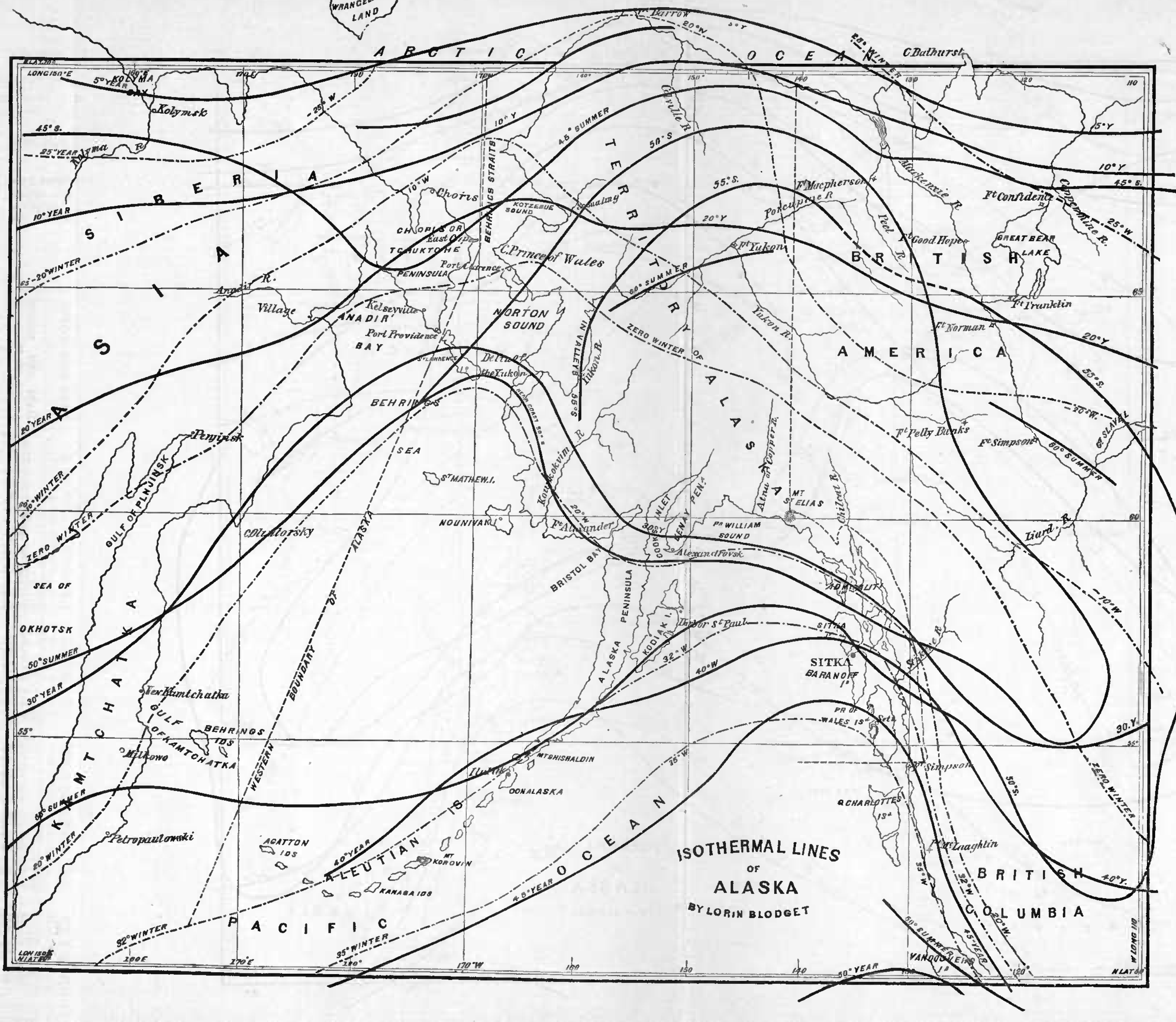
Name.	Residence.	Article.
Marshall, C. K	Vicksburg, Miss	Yamoka, or sweet potato flour.
Masters, J. H	Pres. Neb. State Hort. Soc.	Forty varieties of fruits of Nebraska.
Mason, E. C	Near Mt. Vernon	Talavera, rough chaff, and Boughton wheat.
McChesney, J. H	London, Eng	Specimens of European beet-root sugar.
McDonald, A	Little Rock, Ark	Apples and pears from Arkansas.
McFeely, William J	Centreville, Ind	Ear of 22-rowed corn.
Murphy, J. McLeod	Harlem, N. Y	Specimens of ixtle fiber.
Nebraska State Board of Agriculture.		Fifty specimens Nebraska apples.
Newman, Joseph	Columbia, S. C	Muscadine grapes; pomegranate; muscadine wine; Dickson cotton and seed; squirrel and bird-skins; insects.
Parish, B	Benton, Ill	Samples of wheat.
Parry, Dr. C. C	Washington, D. C	Cotton grown by Moqui Indians, (said to grow wild;) lignite coal, insects, and specimens of corn, Colorado.
Pearce, H. F	Dutchess County, N. Y	Cluster of ten tomatoes.
Pike & Johnston	Carrollton, La	Large quince.
Piper, Irving	North Parsonsfield, Me	Insects.
Piper, John W	South Parsonsfield, Me	Insects.
Powell, Rear-Admiral	United States Navy	Mammoth apple.
Ritz, Philip	Walla-Walla, Wash. Ter	Sample of wheat.
Röezl, B	New Orleans, La	*Lazetta linteria*, Island of Cuba.
Rountree, John		Sample of wheat.
Read, J. B	Tuscaloosa, Ala	Okra paper.
Schaeffer, G. C	Westport, Me	Insects.
Schuyler, E	U. S. Consul, Moscow, Rus.	Specimen of hemp prepared by a new process.
Schott, Dr. A	Washington, D. C	Maguey paper, from *Agave Americana;* tassel from fiber of *Taxqui sabdariffa;* flowers and seed of *Serjanica lucida*.
Simmons, A. H	Walla-Walla, Wash. Ter	Apples and pears.
Sharpless, Samuel J	Philadelphia, Pa	Sample of wheat.
Shields, John	Lancaster County, Pa	Specimens of fruit.
Smith, T. C		Arnautka wheat from Odessa.
Smithsonian Institution	Washington, D. C	Specimens of fruits, seeds, honey, insects, samples of soil, &c., from Indian Territory; specimens of South American woods; wax fruit model; large collection of grains, fibers, and economic substances, from London, England, 1851; four cases Brazilian insects, also collections from Australia, South America, New Mexico, California, and other localities in United States; skins of muscovy duck and wild guinea fowl; articles of food of North American Indians, mammoth hornet's nest, &c.
Steinmetz, S. W	do	Carrier pigeon, (mounted.)
Strickland, William S	Portland, Conn	Samples of sorghum sirup.
Taylor, Dr. L. M	Washington, D. C	South American coleoptera.
Tipton, Hon. T. W		Salt from Nebraska, and one 29-ounce apple.
Thomas, C	Hayden Geol. Survey	Insects, grains, woods, plants, &c., from Colorado.
Thornton, V. B	Yazoo City, Miss	Peeler cotton.
Trook, J. M	Washington, D. C	Gooseberries, (32 to the pound.)
Turney, W. J	Circleville, Ohio	Samples of wheat.
Unknown		Linseed, peanut, and castor oils.
....do		Paper made from ramie.
....do		Herring gull.
Van Ness, J	Wisconsin	Large fresh-water muscle shell.
Walker, Felix	New Orleans, La	Specimen of natural salt from St. Mary's Parish
Warder, Dr. J. A	Cleves, Ohio	Forty-five varieties of Ohio corn.
Walker, R. S	Mansfield Valley, Pa	Horned owl.
Wheeler, D. H	Plattsmouth, Neb	Canary wheat; Thomas's Surprise oats.
Whitcher, J. E	Oakland, Cal	Stalk of wild oats.
Willmuth, J. A. H		Seeds from South America, monkey skin, ostrich egg, &c.
Williamson, A	Treasury Department, Washington, D. C.	Onion grown near Glasgow, Scotland, (very large.)
Williams, Mrs. A. M	Utica, N. Y	Skeleton leaves framed.
Witter, D. K	Woodbine, Iowa	Minerals and grains.
Walter, William	Washington, D. C	Hawk and other bird skins, prepared and mounted.
Woodruff, James	Quincy, Illinois	Specimens of paper made from *Spartina cynosuroides*, with samples of the fiber.
Wright, R	Houston, Tex	Peanuts.
Zantzinger, L. F	Mobile, Ala	Sweet potatoes grafted together.

METEOROLOGY OF 1869.

COMPILED FROM THE REPORTS MADE BY THE OBSERVERS OF THE SMITHSONIAN INSTITUTION, THROUGH DEPARTMENT OF AGRICULTURE.

The following tables exhibit the highest and the lowest range of the thermometer, (with dates prefixed,) the mean temperature, and the amount of rain-fall, (including melted snow,) in inches and tenths, for each month, in the several States and at the stations named. Also the averages of mean temperature and rain-fall for each State. Daily observations were made by the observers, generally, at the hours of 7 a. m. and 2 and 9 p. m.

Stations in States and Territories.	JANUARY.						FEBRUARY.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Houlton	8	41	19, 20	—26	14. 6	3. 60	10,13,22	36	8	—12	19. 0	5. 22
Steuben	8	47	22	— 6	21. 7	2. 40	13	42	8	— 1	25. 3	2. 20
Williamsburg	8	39	18, 23	—12	16. 3	2. 65	13	36	2	0	19. 5	6. 22
West Waterville	7	45	19	— 8	21. 9	2. 15	13	45	25	2	25. 2	6. 45
Gardiner	8	46	19	— 2	22. 7	1. 96	13	44	8	— 5	24. 9	6. 75
Standish	5	42	19	— 3	23. 4	2. 48	13	49	8	0	24. 3	3. 51
Norway	8	46	19	—12	20. 2	......	17	47	25	— 6	23. 2	5. 75
Cornish	8	49	19, 23	— 3	23. 5	2. 15	13	47	2	1	23. 9	3. 75
Cornishville	8	45	22	— 2	23. 8	2. 73	13	45	28	4	24. 0	6. 12
Averages	......	......	......	......	20. 9	2. 52	......	......	......	......	23. 2	5. 11
NEW HAMPSHIRE.												
Stratford	7, 8, 9	38	18	—18	18. 9	2. 98	10	39	8	—12	18. 8	5. 40
Shelburne	8	46	19	—30	20. 7	......	22	46	8	—16	22. 5	4. 03
North Barnstead	7, 30	44	22	0	26. 6	2. 01	13	46	2	5	26. 8	3. 55
Goffstown Center	8	49	20	— 1	23. 5	2. 70	13	50	2	6	26. 5	3. 85
Averages	......	......	......	......	22. 4	2. 56	......	......	......	......	23. 7	4. 21
VERMONT.												
Lunenburg	7, 29	38	19	—20	20. 2	4. 30	10, 13	39	8	—12	20. 1	4. 13
Barnet	6	46	22,23,26	—25	17. 9	2. 70	9	40	8	—16	17. 4	3. 20
North Craftsbury	29	40	22	—16	18. 1	3. 05	11	40	2	—14	18. 7	7. 13
East Bethel	8	46	22	—16	21. 3	3. 23	12	43	8	—17	21. 9	4. 60
Woodstock	8	44	22	—20	19. 1	......	13	43	8	—21	19. 4	4. 00
Near St. Albans	9	45	22	—22	19. 8	......	12	38	8	—15	16. 7	......
West Charlotte	8, 30	45	22	— 6	23. 5	0. 91	11	46	8	— 8	24. 3	4. 31
Middlebury	8, 9	42	18	—11	22. 7	3. 37	13	40	28	— 3	21. 9	4. 45
Brandon	7	50	18, 22	— 8	24. 4	2. 80	9	42	2	— 2	24. 1	4. 12
Averages	......	......	......	......	20. 8	2. 91	......	......	......	......	20. 5	4. 49
MASSACHUSETTS.												
Kingston	8	55	22	5	31. 7	3. 45	13	57	2, 8	10	30. 0	3. 10
Topsfield	8	51	22	0	27. 4	1. 70	13	54	8	5	28. 0	5. 82
Newbury	8	50	26	8	31. 0	3. 40	13	52	8	4	28. 8	5. 45
Georgetown	8	48	22	6	27. 9	2. 81	13	50	8	7	28. 4	14. 31
Lawrence	9	52	22, 23	4	28. 9	......	......	......	......	......	......	......
Milton	8	57	22	9	31. 6	2. 24	13	62	28	9	31. 2	4. 21
Cambridge	29	56	23	6	30. 9	......	13	64	8	9	31. 7	......
North Billerica	8	52	22	3	30. 3	......	13	54	28	1	30. 6	......
West Newton	8	56	22	4	30. 1	......	13	59	28	0	30. 3	......
New Bedford	8	49	22, 23	0	32. 5	3. 84	13	56	2	13	32. 3	4. 85
Worcester	8	53	22	7	28. 9	2. 82	13	52	8	10	28. 3	5. 49
Mendon	8	54	22	4	28. 0	......	13	52	2, 8, 28	10	27. 4	1. 25
Lunenburg	8	53	22	1	27. 8	1. 90	13	53	8	7	27. 3	2. 90


ISOTHERMAL LINES
OF
ALASKA
BY LORIN BLODGET
ARCTIC OCEAN
PACIFIC OCEAN
SIBERIA
ASIA
TERRITORY OF ALASKA
BRITISH AMERICA
BRITISH COLUMBIA
KAMTCHATKA
BEHRINGS SEA
SEA OF OKHOTSK
NORTON SOUND
BRISTOL BAY
ALASKA PENINSULA
ALEUTIAN IS
WRANGELLS LAND
SITKA
MT ST ELIAS
Yukon R.

Meteorology of 1869—Continued.

Stations in States and Territories.	January.						February.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MASS.—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Amherst	8	49	23	3	28.0	3.47	13	51	8	— 1	28.0	4.17
Richmond	8	54	23	2	26.6	1.80	13	58	8	2	26.8	5.72
Williams College	8	48	23	5	26.9	3.52	13	54	8	— 2	28.5	3.78
Hinsdale	9	47	22, 23; 25, 26	0	24.7	4.20	13	47	2	4	23.7	5.10
Averages	......	......	......	......	29.0	2.93	......	......	......	......	28.8	5.09
RHODE ISLAND.												
Newport	8	52	23	10	31.1	2.70	13	47	2,6,8,28	18	32.4	6.84
CONNECTICUT.												
Pomfret	8	51	22, 23	5	29.2	1.75	13	52	28	8	27.7	4.40
Columbia	9	56	23	6	31.7	......	13	64	28	8	31.2	......
Middletown	8	56	22	5	31.0	2.93	13	63	8	9	30.0	3.84
Waterbury	8	52	23	4	30.0	2.71	13	57	8	7	30.2	3.89
Colebrook	8	53	23	— 1	26.2	......	13	54	28	5	25.2	1.87
Brookfield	30	52	26	5	30.7	5.08	13	50	8	8	29.3	7.60
Averages	......	......	......	......	29.8	3.12	......	......	......	......	28.9	4.32
NEW YORK.												
Moriches	29	60	26	11	36.8	3.73	13	58	8	15	36.5	7.88
South Hartford	8	50	26	— 7	25.7	3.40	9	48	8	—10	25.8	4.35
Garrison's	30	52	22, 23	5	31.0	3.73	13	57	8	12	31.0	2.49
Throg's Neck	8, 30	54	22, 26	13	32.7	......	13	58	28	14	33.2	......
White Plains	8, 9, 29	53	22	8	32.9	......	15	65	28	14	32.4	......
Deaf & Dumb Inst	8, 30	51	22, 26	12	32.7	4.18	13	57	28	14	32.8	7.29
Columbia College	8	51	26	13	31.4	2.42	22	46	28	15	32.7	4.60
Flatbush	14	59	26	13	34.8	1.78	13	58	28	15	34.2	4.13
Nyack	30	70	23	15	35.6	......	13	63	28	17	35.0	5.47
Newburg	30	55	22	7	31.4	3.53	13	64	2, 8	12	31.5	2.65
Minaville	8	42	25	— 1	22.5	2.75	13	48	8	— 6	22.2	1.57
Sloansville	9	52	22	— 3	27.2	4.29	13	60	2	1	25.1	3.76
Gouverneur	4	48	22, 25	—10	22.8	2.35	11	42	28	—18	20.4	5.15
North Hammond	6, 7	48	25	—10	23.0	2.40	11	42	28	— 8	22.6	4.90
Houseville	7	46	25	—12	24.6	3.99	13	45	28	— 8	22.4	4.25
Leyden	7, 8	43	22	— 3	25.9	5.55	13	50	28	3	25.2	4.35
South Trenton	29	48	22	— 3	23.0	2.87	10	44	2, 28	— 4	22.2	4.55
Cazenovia	29	48	22	1	27.3	......	13	55	7	0	25.8	4.18
Oneida	4	50	22	4	27.0	3.93	12, 13	48	8	— 2	26.5	4.41
Depauville	4	48	25	0	25.5	1.86	12	40	28	— 4	21.5	5.01
Oswego	7, 9	45	22	6	29.7	4.30	12	44	8	9	27.2	4.50
Palermo	7	44	22	0	24.5	2.58	12	45	28	— 8	22.3	3.90
North Volney	7	49	22	3	27.1	......	13	46	7	3	25.5	......
Ludlowville	4, 7	50	22	— 2	27.7	......	12	60	6, 8	0	27.8	......
Nichols	7, 30	50	22	0	28.9	......	13	62	8	0	28.2	......
Newark Valley	7, 8, 9	46	22, 23	—10	25.5	3.68	13	57	6, 8	— 8	25.9	......
Rochester	4	52	22	5	30.1	1.35	12	49	28	13	29.3	4.13
Little Genesee	7	50	22	— 6	27.4	2.65	13	60	25	— 6	25.8	2.06
Suspension Br'ge	7	51	25	8	30.1	3.45	13	50	27	11	26.5	5.75
Buffalo	4	50	25	11	30.8	1.40	12, 13	46	27	9	27.3	4.87
Averages	......	......	......	......	28.5	3.14	......	......	......	......	27.5	4.43
NEW JERSEY.												
Paterson	9, 30	51	23	3	31.2	2.83	13	57	28	11	32.3	6.06
Newark	30	52	23	11	32.7	3.42	13	60	28	15	33.3	5.06
New Brunswick	9	52	22	10	31.0	......	......	......	......	......	......	......
Trenton	9, 30	54	23	13	35.3	2.12	13	52	28	13	37.3	3.52
Rio Grande	......	......	......	......	......	......	13	66	28	16	38.5	7.00
Moorestown	30	60	23	9	34.0	3.82	13	64	28	13	34.7	4.86
Newton	8	51	23	2	28.9	4.05	13	52	8	7	28.9	1.88

Meteorology of 1869—Continued.

Stations in States and Territories.	JANUARY.						FEBRUARY.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. JERSEY—Cont.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Dover	8	58	23, 26	12	33.4	4.44	11	46	8	12	......	......
New Germantown	30	50	22, 23	9	32.5	3.34	13	59	28	10	32.5	3.51
Readington	8	55	22, 23 / 26, 27	16	33.9	......	......	......	......	......	......	......
Haddonfield	9	59	23, 26	17	34.0	3.67	......	......	......	......	......	......
Newfield	9	61	23	10	36.6	......	14	68	28	11	36.0	......
Greenwich	30	61	26	18	36.7	3.65	14	63	28	17	37.7	3.57
Vineland	8	66	23	10	35.8	4.15	14	70	28	13	37.8	4.45
Averages	......	......	......	......	33.5	3.55					34.9	4.43
PENNSYLVANIA.												
Nyces	7	61	23, 25	— 8	26.8	1.50	13	58	8	— 4	26.2	3.68
Dyberry	7, 8	54	23	—11	26.4	......	12, 13	49	8	— 6	24.7	......
Fallsington	30	56	23	14	34.0	4.00	13	60	23	15	35.0	5.10
Philadelphia	9	58	26	19	36.7	3.23	13	61	28	17	37.6	4.49
Germantown	30	60	23	13	34.3	......	15	56	28	15	33.2	......
Horsham	9, 30	55	23	11	33.4	2.63	13	65	28	13	34.3	3.25
Plym'th Meeting	30	58	26	17	34.5	3.68	13	64	28	14	35.1	4.34
Whitehall	9, 29, 30	49	23, 26	12	32.2	......	13	54	28	10	32.4	......
Factoryville	9	50	27	2	28.6	5.80	13	54	8	2	28.2	2.70
Reading	9	56	26	17	35.1	......	13	62	28	16	35.9	......
Parkersville	7	55	26	17	33.7	3.10	15	54	28	12	34.3	4.35
West Chester	7	62	26	13	35.0	4.09	13	66	28	13	33.6	4.20
Phenixville	9	58	26	16	34.2	4.75	13	62	28	14	33.9	5.50
Ephrata	30	60	26	14	34.8	3.55	13	64	28	14	35.1	4.88
Silver Spring	29	54	26	15	34.6	......	15	54	28	16	35.0	......
Mount Joy	30	60	26	19	......	......	13	64	28	18	36.7	......
Harrisburg	30	50	23	18	33.3	4.22	13	59	28	18	34.9	3.50
Carlisle	28	51	23	13	33.3	3.95	13	65	28	15	34.7	3.60
Fountain Dale	7	54	23	19	34.3	2.66	13	65	28	15	35.0	4.18
Tioga	8, 9	46	23	—12	23.3	3.15	13	54	6, 8	— 6	22.2	1.70
Lewisburg	24	45	23	2	29.3	2.10	11	48	8	6	30.3	1.62
Ickesburg	7	53	23	6	31.7	4.36	13	67	25	10	32.2	3.86
Grampian Hills	8, 9	46	27	— 2	26.5	5.12	13	58	25	— 3	25.7	2.35
Johnstown	7	50	27	14	29.7	......	13	58	28	8	31.7	......
Franklin	7	54	23	6	30.3	3.92	13	64	28	0	29.3	3.70
Connellsville	4	64	27	13	35.1	......	14	68	28	2	33.0	......
New Castle	4	59	26	9	33.6	......	13	60	28	4	32.7	......
Beaver	4	59	26	11	35.0	3.60	13, 14	57	25	11	36.0	4.00
Canonsburg	4	63	23	13	36.1	4.64	13	68	27	6	33.9	2.05
Averages	......	......	......	......	32.4	3.70	......	......	......	......	32.5	3.65
MARYLAND.												
Woodlawn	30	62	26	14	35.6	4.26	13	64	28	14	35.9	4.67
Annapolis	29	64	26	21	40.8	4.70	13, 15	56	28	18	41.6	5.45
St. Inigoes	29	62	26	25	39.7	3.92	13	62	28	20	37.7	5.56
Emmittsburg	7	68	26	14	34.5	......	13	71	28	14	32.8	......
Mt. St. Marys	30	54	26	17	34.7	4.51	13	64	28	14	35.1	4.12
Averages	......	......	......	......	37.1	4.35	......	......	......	......	36.6	4.95
DIST. COLUMBIA.												
Washington	28, 29	54	2	28	39.3	4.10	13	58	28	20	39.7	4.10
VIRGINIA.												
Johnsontown	30	64	23	25	42.1	4.75	13	66	5, 28	24	42.3	3.00
Hampton	9, 30	64	19,21,26	30	42.9	2.90	15	69	28	24	43.5	2.50
Zuni Station	30	64	21	28	43.7	3.11	14	70	6	24	44.9	4.25
Bacon's Castle	29	72	13	25	46.4	......	14	73	28	25	45.6	......
Ashland	30	65	26	24	43.9	5.35	......	......	......	......	......	......
Comorn	29	63	26	24	41.0	3.30	13, 14	68	28	23	41.8	3.37

Meteorology of 1869—Continued.

Stations in States and Territories.	JANUARY. Date.	JANUARY. Maximum temperature.	JANUARY. Date.	JANUARY. Minimum temperature.	JANUARY. Mean temperature.	JANUARY. Rain and melted snow.	FEBRUARY. Date.	FEBRUARY. Maximum temperature.	FEBRUARY. Date.	FEBRUARY. Minimum temperature.	FEBRUARY. Mean temperature.	FEBRUARY. Rain and melted snow.
VIRGINIA—Cont'd		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Mount Solon	7	66	13, 23	22	43.6	4.25	13	76	6	16	42.1	3.96
Staunton	8	61	13	23	41.0	2.87	13	62	28	18	39.5	2.94
Lexington	......	......	......	......	......	......	13	73	6	12	40.7	2.65
Lynchburg	7, 28	59	13	32	45.1	......	12	67	28	22	44.1	......
Snowville	9	63	13	17	39.1	10.20	12, 14	62	6	12	37.1	10.20
Near Wytheville	4	59	13	15	38.8	2.20	13	65	6	14	37.3	2.80
Averages	......	......	......	......	42.5	4.33	......	......	......	......	41.7	3.96
WEST VIRGINIA.												
Romney	7	70	23	18	36.9	......	......	......	......	......	......	......
White Day	4	65	26	26	38.7	......	14	70	6	4	37.5	......
Weston	7, 9	60	23	20	37.7	......	......	......	......	......	......	......
Cabell C. H	8	62	26	18	42.6	1.20	21	60	26	16	38.6	2.10
Averages	......	......	......	......	39.0	1.20	......	......	......	......	38.1	2.10
NORTH CAROLINA.												
Kenansville	30	74	13, 14	32	51.6	6.51	21	74	6	26	48.9	4.65
Goldsboro	30	73	14	29	49.5	3.60	15	75	5	26	50.3	3.25
Raleigh	29	71	13	29	47.3	3.50	13, 14	73	28	24	47.2	8.80
Oxford	29	66	26	25	42.0	4.85	13, 14	66	1	20	43.1	6.56
Trinity College	......	......	......	......	......	......	12	68	5	22	44.2	13.00
Albemarle	9, 29	70	13	18	43.9	5.03	13	71	6, 28	16	43.4	4.75
Statesville	28	58	13	20	39.7	3.50	19	62	28	15	38.9	5.63
Asheville ...(A.)	7, 15, 28	60	13	20	42.5	1.80	13	62	24, 28	16	40.2	......
Do ......(H.)	15	62	13	20	43.0	......	12, 13	62	24, 28	14	42.3	......
Averages	......	......	......	......	44.9	4.11	......	......	......	......	44.3	6.66
SOUTH CAROLINA.												
Camden	15, 29	68	13	22	47.7	2.82	19, 20	69	6	19	47.0	5.45
Aiken	29	68	19	32	50.3	5.41	13	70	28	25	49.0	6.73
Gowdeysville	......	......	......	......	......	......	19	69	22	22	50.1	......
Averages	......	......	......	......	49.0	4.12	......	......	......	......	48.7	6.09
GEORGIA.												
Penfield	29	64	13	29	48.1	3.55	13	69	24, 28	22	47.4	5.00
Macon ......(A.)	8	69	13	28	53.5	5.70	12	70	28	26	48.7	6.48
Do .....(W.)	8	66	13	30	50.1	4.78	12	69	28	23	47.7	6.20
Atlanta	3, 8, 15	63	13	25	46.1	5.86	13	67	24, 28	16	43.7	9.93
Averages	......	......	......	......	49.5	4.97	......	......	......	......	46.9	6.90
ALABAMA.												
Carlowville	29	72	12	30	50.2	8.30	13	74	28	27	50.9	10.82
Moulton	29	61	12	23	45.9	4.87	21	63	28	20	43.4	3.98
Greene Springs	24	69	13	24	47.7	5.96	14	75	28	24	48.3	9.16
Havana	20	68	13	27	48.7	5.90	12, 13	70	24, 28	24	49.1	9.30
Averages	......	......	......	......	48.1	6.26	......	......	......	......	47.9	8.32
FLORIDA.												
Port Orange	15, 30	78	13	47	59.4	......	22	85	5	40	60.0	......
Jacksonville	4, 29	79	13	36	57.1	4.05	22	79	5, 24	40	59.4	7.25
Pilatka	......	......	......	......	......	......	22	87	5	35	60.7	4.90
Ocala	15	78	13	38	62.9	......	22	84	6	36	62.6	......
Manatee	1, 3	84	13	44	67.0	4.38	21, 22	82	6	44	65.0	1.60
Lake City	2, 3	78	13	32	58.7	9.38	......	......	......	......	......	......
Averages	......	......	......	......	61.0	5.94	......	......	......	......	61.5	4.58

Meteorology of 1869—Continued.

Stations in States and Territories.	January. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	February. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
TEXAS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Gilmer	25	69	11	23	49.2	3.65	11	74	22, 23, 24	20	48.6	3.42
Galveston	8	76	17	31	55.2	10.00	......	......	......	......	......	......
Houston	1	80	11	32	54.2	......	20	76	23	26	54.6	......
Columbia	3, 4	77	11	28	55.6	4.54	20	80	23	26	55.7	3.04
Blue Branch	3	80	11, 23	38	52.6	9.33	10	77	22	29	52.0	2.97
Lavaca	27, 28	78	18	40	......	......	20	80	23	27	56.0	3.01
Waco	3	70	11	28	51.4	5.10	11	73	23	20	51.8	3.00
Austin	3	73	11	27	51.0	5.06	20	83	23	28	52.4	0.61
Yorktown	7, 28	76	11	36	55.9	4.05	......	......	......	......	......	......
Averages					53.1	5.96					53.0	2.68
LOUISIANA.												
New Orleans	8	72	11	41	......	......	20	78	23	35	......	......
Shreveport	6	70	12	29	49.3	......	......	......	......	......	......	......
MISSISSIPPI.												
Columbus	29	66	12	22	46.5	6.15	21	68	24, 28	26	47.3	7.26
Marion C. H	2	68	12	24	46.0	9.30	14	78	28	18	47.5	7.70
Grenada	4, 28	68	12	24	49.6	3.40	21	74	28	20	49.5	5.20
Near Brookhaven	29	67	12	28	50.5	7.00	20	78	23	26	51.4	10.20
Natchez	8	67	12	25	46.5	5.97	13	71	5, 23; 24, 28	27	48.6	7.47
Averages					47.8	6.36					48.9	7.57
TENNESSEE.												
Elizabethton	29	66	13	22	42.3	4.80	13, 21	69	5, 24, 28	16	40.7	2.70
Tusculum College	29	64	13	22	40.9	......	13	68	5	17	39.0	......
Lookout Mount'n	8	68	12	20	45.9	......	19	65	28	12	43.7	......
Clarksville	29	63	12	13	42.0	2.88	13	68	28	15	42.2	3.14
Trenton	......	......	......	......	......	......	21	67	27	16	44.4	5.45
Memphis	3, 28	65	12	24	44.4	2.24	12	71	23	17	44.7	3.97
Averages					43.1	3.31					42.5	3.82
KENTUCKY.												
Pine Grove	3, 4, 29	60	26	20	39.2	2.67	13	66	28	10	38.7	2.54
Lexington	4, 29	61	13, 26	20	38.8	2.85	13	67	5	6	38.6	3.06
Danville	3	68	10	23	44.0	2.89	12, 13	74	28	12	44.9	1.87
Louisville	7, 28, 29	62	12	6	39.1	2.80	13	70	28	12	40.7	3.50
Clinton	3	63	12	20	40.3	1.58	13	63	27	14	40.8	3.82
Averages					40.3	2.56					40.7	2.96
OHIO.												
New Lisbon	4	60	23	8	34.1	3.44	13, 14	65	28	−4	32.9	1.84
Steubenville	9	58	23, 27	16	36.0	3.38	13	62	26	12	36.0	2.06
Martin's Ferry	4, 7	60	27	11	35.4	2.25	13	67	5, 27	12	34.5	2.69
Painesville	4	54	25, 26	18	32.8	1.13	13	64	28	6	30.6	4.65
Gilmore	4, 7, 8	60	26	11	33.6	2.70	14	68	28	6	32.9	3.10
Milnersville	4	60	23, 26	7	32.8	5.05	13	67	6	3	32.3	2.85
Cleveland	4	59	26	17	33.2	1.47	13	67	28	1	30.7	3.02
Wooster	4	60	12, 23, 25, 26, 27	16	34.3	2.30	13	70	28	−2	33.5	2.05
Gallipolis	29	64	13, 26	20	38.9	2.96	13	68	23	17	39.4	2.94
Kelley's Island	4	50	25	17	33.2	0.71	13	56	28	12	30.7	2.67
Sandusky	7	57	25	14	34.3	1.22	13	65	28	5	32.5	3.45
North Fairfield	4	60	25	14	34.2	1.28	13	68	28	5	32.3	3.99
Carson	......	......	......	......	......	......	13	61	25, 28	10	32.5	2.50
Westerville	4	57	26	15	34.2	1.80	13	67	5	9	34.1	2.98

Meteorology of 1869—Continued.

Stations in States and Territories.	January. Date.	January. Maximum temperature.	January. Date.	January. Minimum temperature.	January. Mean temperature.	January. Rain and melted snow.	February. Date.	February. Maximum temperature.	February. Date.	February. Minimum temperature.	February. Mean temperature.	February. Rain and melted snow.
OHIO—Continued.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Marion	4	56	25, 26	14	32. 8	1. 50	13	65	25	6	31. 0	3. 15
Hillsboro	4	56	26	18	34. 7	1. 86	13	64	28	11	34. 9	3. 25
Toledo	7	55	25	14	33. 0	1. 69	13	65	28	3	30. 3	3. 44
Bowling Green	7	59	25	12	35. 1	1. 75	12	63	28	3	30. 9	5. 69
Springfield	4, 29	55	13	22	38. 2	3. 84	.....	.....	.....	.....	.....	.....
Urbana Univers'y	4, 7	58	23	18	33. 4	1. 50	13	66	28	9	32. 9	3. 40
Bethel	7	61	26	16	36. 7	2. 25	13	67	28	11	35. 8	2. 63
Jacksonburg	4	69	26	17	35. 0	2. 04	13	67	28	8	34. 9	3. 57
Mt. Auburn Inst.	4	66	26	21	39. 7	1. 68	12, 13	68	28	11	39. 3	3. 20
Cincinnati ..(H)	4, 7	69	26	16	36, 5	1. 60	13	67	28	13	36. 6	2. 51
Do.... ..(P)	7	64	13, 26	26	40. 6	2. 37	12, 13	70	28	19	41. 7	3. 05
Cleves	4, 29	60	26	18	36. 2	1. 88	.....	.....	.....	.....	.....	.....
College Hill	4	60	26	18	35. 9	1. 73	12	62	28	10	35. 3	3. 44
Averages	.....	.....	.....	.....	35. 2	2. 13	.....	.....	.....	.....	34. 0	3. 12
MICHIGAN.												
Monroe City	4	54	25	12	33. 3	0. 40	13	69	28	5	31. 0	4. 55
Alpena	12	40	27	8	24. 6	3. 48	12	40	27	8	24. 6	3. 48
Adrian	.....	.....	.....	.....	.....	.....	13	62	27	2	23. 2	.....
State Agr'l Col.	7	50	25	4	29. 4	0. 47	12	60	5	— 4	26. 7	2. 95
Litchfield	7	51	25	9	28. 6	1. 25	13	62	5	4	27. 5	2. 85
Cold Water	7	50	25	10	29. 2	3. 13	13	64	25, 28	6	28. 3	1. 78
Grand Rapids	7	47	25	8	29. 8	.....	12	56	4	— 1	28. 0	1. 88
Northport	6, 13	43	25	5	28. 1	2. 30	10	45	27	4	24. 5	1. 63
Homestead	7, 14	43	12, 26	6	28. 1	.....	12	47	28	— 4	25. 4	.....
Muskegon	6, 8, 15	45	25	8	35. 5	1. 20	12	52	4	2	29. 1	1. 10
Holland	7	46	25	11	32. 8	2. 07	13	56	5	0	31. 2	3. 48
Otsego	14, 15	50	15	18	33. 8	.....	12	68	5	14	34. 6	.....
Copper Falls	6	35	24	— 3	20. 1	3. 49	11	36	24	— 1	15. 4	4. 03
Penn Mine	6	44	24	— 2	.....	.....	12	40	17	— 3	20. 2	.....
Ontonagon	6, 7	38	11, 24, 25	8	26. 0	.....	11, 12	46	27	—24	21. 2	1, 60
Averages	.....	.....	.....	.....	29. 2	1. 97	.....	.....	.....	.....	26. 1	2. 67
INDIANA.												
Aurora	4	60	26	13	33. 9	1. 08	13	66	27, 28	14	35. 0	3. 30
Vevay	29	61	26	15	31. 1	1. 87	13	70	27, 28	13	38. 0	4. 05
Muncie	7	58	16	10	33. 5	2. 05	13	66	28	5	33. 9	4. 40
Spiceland	7	57	16	11	33. 7	1. 73	13	66	28	8	33. 9	3. 20
New Albany	.....	.....	.....	.....	.....	.....	12, 13	67	28	12	39. 9	2, 83
Columbia City	7	51	26	10	31. 5	1. 20	.....	.....	.....	.....	.....	.....
Jalapa	7	59	26	18	34. 9	3. 56	12	67	28	6	34. 6	5. 94
Knightstown	4, 7	56	16	14	33. 6	1. 98	13	65	23	9	34. 9	4. 03
Indianapolis	7	59	10	21	36. 5	3. 35	13	65	23, 24, 28	9	34. 0	3. 70
Bloomington	7	59	10	—12	36. 1	2. 51	13	65	28	9	35. 3	3. 37
Rensselaer	29	53	31	10	31. 2	2. 20	.....	.....	.....	.....	.....	.....
Lafayette	.....	.....	.....	.....	.....	.....	12	64	28	4	32. 0	3. 70
Merom	7	58	12, 31	21	36. 8	1. 10	13	65	28	8	35. 2	3. 28
Kentland	.....	.....	.....	.....	.....	.....	11, 12	60	27	6	31. 3	10. 47
New Harmony	7, 28	59	31	23	39. 8	1. 30	12, 13	66	28	13	41. 4	3. 80
Averages	.....	.....	.....	.....	34. 4	1. 99	.....	.....	.....	.....	35. 3	4. 31
ILLINOIS.												
Chicago	7	51	26	16	33. 7	1. 97	12	65	28	5	31. 8	2. 24
Near Chicago	7	46	26	10	30. 4	.....	12	60	28	3	27. 2	.....
Evanston	7	46	25	12	32. 7	0. 93	12	59	27	6	30. 3	2. 94
Marengo	7	47	25	4	28. 9	1. 65	12	57	5	0	27. 1	1. 65
King's Mills	7	43	12	4	27. 2	2. 40	12	58	27, 28	— 2	24. 2	1. 98
Louisville	.....	.....	.....	.....	.....	.....	.....	.....	27, 28	10	.....	.....
Golconda	16	80	31	4	44. 7	1. 40	21	81	23	10	44. 5	1. 20
Belvidere	7	48	25	3	26. 3	2. 11	12	59	5	— 8	25. 3	2. 68
Sandwich	7	47	26	7	28. 3	1. 40	12	60	5	— 7	25. 6	3. 10
Ottawa	.....	.....	.....	.....	.....	.....	12	66	28	4	32. 3	1. 85

Meteorology of 1869—Continued.

Stations in States and Territories.	JANUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	FEBRUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ILLINOIS—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Winnebago	28	45	25	4	25.8	1.39	12	58	27	0	24.5	2.14
Rochelle	7	47	10, 26	6	30.7	......	12	61	27, 28	— 4	25.5	......
Wyanet	28	55	10, 26	12	31.6	1.96	12	68	23	— 2	28.1	1.52
Tiskilwa	29	51	26	10	31.3	......	12	62	28	0	29.8	......
Hennepin	29	52	26	10	32.0	......	12	66	28	0	30.0	......
Elmira	7, 28	48	26	7	27.9	1.17	12	62	5	— 7	26.6	2.86
Peoria	7	55	26	18	34.0	0.99	12	69	27	— 4	31.2	2.62
Springfield	6, 7	50	10, 25	18	28.5	......	12	70	27	4	31.1	......
Loami	7	59	16	17	33.6	1.25	12	68	27	2	31.9	2.95
Dubois	7	62	12	17	37.7	1.47	12	69	28	7	37.0	3.75
Waterloo	......	......	......	......	......	......	12	69	23	10	39.1	1.14
South Pass	28	60	12, 19	20	39.6	......	12	68	23, 28	10	37.9	......
Galesburg	28, 29	54	10	9	31.0	1.62	11	57	27, 28	— 1	27.2	1.20
Manchester	7	59	19	17	34.5	3.67	12	70	27	3	32.4	1.97
Mount Sterling	3	60	10	16	36.0	......	12	68	27	— 4	31.4	......
Andalusia	15	57	10	9	31.3	......	12	68	5	— 2	30.3	......
Augusta	7	53	10	12	33.2	2.19	12	64	28	— 2	30.1	2.57
Warsaw	7	65	10	10	32.1	2.22	12	67	23	— 4	28.2	1.88
Averages	......	......	......	......	32.1	1.75	......	......	......	......	30.4	2.22
WISCONSIN.												
Manitowoc	6	46	26	4	27.4	2.76	12	48	28	0	25.8	2.52
Plymouth	7, 28	41	11	— 6	24.0	2.00	12	47	27	— 2	23.0	2.30
Hingham	14	48	26	0	26.6	......	12	50	27	— 2	24.6	......
Milwaukee	7	47	25	5	29.1	2.51	12	56	27	2	26.7	2.76
Appleton	14	47	11	2	26.5	2.08	12	47	27	— 2	25.6	......
Waupacca	21	46	11	—13	25.5	......	10, 11	48	4, 24	0	24.2	......
Embarrass	23	44	11	— 8	21.3	1.88	12	45	27	— 9	22.3	2.40
Rocky Run	6	45	11	—15	23.1	2.75	12	50	5	— 5	24.4	1.98
Madison	6	42	11	—11	23.3	2.69	12	50	27	— 1	22.9	2.35
Edgerton	7, 22, 28	50	11	— 6	25.3	1.80	12	60	5	— 3	24.2	......
Baraboo	19	36	10	—10	18.8	4.75	12	50	23, 24, 28	0	24.9	......
New Lisbon	6	50	11	—18	23.3	......	12	57	5	—17	23.9	......
Bayfield	6, 23	42	26	— 8	21.6	......	16	46	23	—12	19.8	......
Averages	......	......	......	......	24.3	2.58	......	......	......	......	24.0	2.39
MINNESOTA.												
Beaver Bay	7	41	25	— 7	23.4	0.28	12	45	27	—12	19.9	0.70
Afton	23	39	26	—13	18.6	0.80	11	43	22	—24	17.5	2.47
St. Paul	3, 23	36	25	— 7	19.4	0.42	12	41	27	—15	18.7	2.83
Minneapolis	23	39	25	—13	18.0	0.06	11, 12	42	22, 27	—18	17.6	2.80
Sibley	3, 27	36	25	—19	15.4	0.30	11	39	27	—21	15.2	2.30
Sauk Center	6	38	25	—26	13.2	0.32	......	......	......	......	......	......
Koniska	2	36	9	—14	16.2	......	12	40	27	—26	15.0	2.20
New Ulm	6	38	25	—15	17.3	0.38	8, 10, 11, 16	37	22, 27	—17	16.7	2.43
Madelia	6, 19	38	25	—16	15.6	0.50	7, 10	40	22	—22	15.2	3.50
Averages	......	......	......	......	17.5	0.38	......	......	......	......	17.0	2.40
IOWA.												
Clinton	3, 25	50	27	10	30.2	1.50	12	65	23, 24	— 4	27.2	5.26
Davenport	28	49	10	5	28.1	3.74	12	60	23	— 4	26.7	3.53
Dubuque	6, 7	44	11	—15	23.9	3.45	12	56	5	— 2	26.0	2.24
Monticello	6	45	11	—20	22.3	1.71	12	56	5	— 8	24.5	1.13
Bowen's Prairie	25	45	11	—24	22.1	1.50	11, 12	64	23	—14	24.0	2.00
Muscatine	28	54	10	0	26.3	1.52	12	62	5	—12	28.5	1.58
Fort Madison	7, 29	52	10	6	31.3	1.21	12	68	23, 27	— 3	29.5	2.45
Guttenberg	6	46	11	—20	20.3	......	12	56	5	—16	23.2	......
Mount Vernon	3, 6	44	11	— 8	24.4	......	12	59	23	— 7	23.7	......
Iowa City	23	48	11	—14	26.0	4.81	12	62	5	— 8	27.0	3.90
Independence	3, 27	39	11	—21	19.2	2.50	12	53	23	—21	21.2	3.10
Near Independ'ce.	3	42	10	—21	19.0	1.00	12	58	5	—19	19.9	3.15

Meteorology of 1869—Continued.

Stations in States and Territories.	JANUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	FEBRUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
IOWA—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Waterloo	6	40	11	—18	19.2	......	12	48	22, 28	— 8	23.0	......
Rockford	3	40	25	— 6	20.2	......	12	48	27	—10	23.1	......
Iowa Falls	3	40	10	— 6	22.8	2.07	11, 12	50	23	—10	24.2	3.97
Algona	21	40	25	—10	17.2	1.23	11	41	22	—14	19.2	......
West Bend	3, 27	38	25	—11	15.9	1.10	1, 11	40	22	—18	17.4	2.28
Fort Dodge	6	36	25	—14	18.1	1.75	11	45	22	—10	21.7	1.46
Boonesboro'	3	40	25	—10	21.3	1.38	12	56	27	— 9	22.7	1.84
Fontanelle	6	42	25	—10	22.5	0.85	12	56	27	— 6	25.3	1.68
Rolfe	27	42	25	—18	15.6	0.70	11	46	22, 27	—12	19.2	1.93
Lizard	......	......	......	......	......	......	10	61	27	— 4	25.5	4.98
Grant City	12	46	25	—16	18.8	......	11, 12	48	22	—14	23.6	......
Logan	21, 22	48	25	— 6	23.3	0.90	12, 13, 18	48	4, 22, 27	— 4	24.6	1.49
Woodbine	6	42	25	—10	22.6	......	12	53	22	— 6	25.9	......
Averages	......	......	......	......	22.1	1.83	......	......	......	......	23.9	2.66
MISSOURI.												
St. Louis Univ	7	62	12, 31	27	40.6	1.73	12	70	27	12	38.4	1.82
Allenton	6	67	31	14	36.6	1.94	12	77	23, 28	7	36.0	2.45
Hematite	6	68	12, 31	17	39.8	1.40	12	75	28	9	38.9	2.10
Rolla	27	65	12	15	37.3	2.06	12	76	23	1	41.6	1.57
Jefferson City	7	64	11	17	38.0	......	12	72	23	4	37.0	......
Hermitage	3	62	10	15	34.7	2.68	12	70	23	— 1	34.6	1.96
Bolivar	3	63	11	15	38.6	4.50	12	70	23	1	38.2	0.95
Warrensburg	28	58	10	10	38.4	3.53	12	70	27	0	30.4	0.50
Harrisonville	4, 28	56	10	12	33.1	4.08	12	64	23	— 2	33.1	1.03
St. Joseph	6, 28	54	10	10	34.1	1.28	12	68	23	2	35.3	1.98
Oregon	6	56	10	4	31.0	2.06	12, 13	68	23	— 5	31.2	2.51
Averages	......	......	......	......	36.1	2.53	......	......	......	......	35.9	1.69
KANSAS.												
Atchison	6	54	10	2	30.6	2.70	11, 12	68	23, 27	— 4	30.9	1.65
Leavenworth	28	57	10	5	30.1	3.45	12	68	23	— 6	30.7	1.84
Olathe	28	56	10	6	31.3	3.90	12	67	23	— 4	32.1	1.30
Baxter Spring	3	67	11	18	40.0	5.75	12	74	23	— 7	39.0	2.80
Lawrence	28	55	10	6	30.5	2.90	12	66	23	— 3	30.6	1.44
Holton	6	50	10	3	30.6	......	11	62	23, 27	— 3	30.2	......
Le Roy	6	60	10	13	36.3	2.45	12	70	23	— 4	33.6	1.95
Neosho Falls	4, 5	56	10	11	32.0	4.10	12	65	23	— 9	31.3	1.60
State Agr'l Col.	28	54	10, 25	9	30.6	1.15	12	65	23	— 4	31.3	1.22
Council Grove	28	58	10, 11	12	35.4	2.75	11, 12	66	23	0	34.5	0.65
Averages	......	......	......	......	32.7	3.24	......	......	......	......	32.4	1.16
NEBRASKA.												
Dakota	27	46	25	— 6	23.9	0.55	8, 12	55	22	— 5	27.0	......
Omaha Mission	3	50	25	0	27.6	0.13	10, 28	50	20, 21, 22, 27	3	27.5	1.65
Elkhorn	21	44	25	— 2	24.9	......	12	55	22	— 2	27.7	......
De Soto	21	43	25	— 4	24.7	0.60	12	53	22	— 6	26.8	1.48
Bellevue	6, 27	46	25	2	26.3	0.90	12	63	4	— 2	30.6	2.00
Glendale	21	49	25	— 2	23.4	1.30	12	63	4	—10	27.5	2.45
Nebraska City	21	50	25	2	28.6	1.15	12	64	4	0	31.7	2.60
Peru	21, 27	47	25	3	28.0	0.43	12	67	29	— 3	30.3	1.05
Averages	......	......	......	......	25.9	0.72	......	......	......	......	28.6	1.87
UTAH TERRITORY.												
Wanship	24	42	18	—20	20.5	1.70	......	......	......	......	......	......
CALIFORNIA.												
Monterey	10, 27	63	19	32	50.3	3.83	28	71	22	32	49.4	4.13

Meteorology of 1869—Continued.

Stations in States and Territories.	JANUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	FEBRUARY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
CALIFORNIA—Con.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Murphy's	5	63	16, 19, 20	23	42.0	7.50	17, 27, 28	66	22	24	42.2	6.31
Paradise City	3, 25	60	19	23	45.5	2.62	......	......	......	......	45.6	3.53
Watsonville	4, 26	65	13, 16	30	51.5	7.40	27	78	22	32	45.0	5.30
Averages	......	......	......	......	47.3	5.34	......	......	......	......	45.6	4.82
MONTANA TER'Y.												
Fort Benton	11	46	1	—12	30.8	1.75	27	76	20	— 6	33.1	0.40
Deer Lodge City	5	44	8	—11	20.4	3.25	17	42	21	—33	24.4	3.50
Averages	......	......	......	......	25.6	2.50	......	......	......	......	28.8	1.95
ALASKA.												
Sitka	14, 19	44	2, 4, 27	30	38.4	5.33	26	47	9, 10	30	......	4.98

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.												
Houlton	27	53	2	—23	19.6	8.65	17, 30	65	5	21	40.4	1.50
Steuben	28	50	6	— 4	26.4	3.54	27	59	5	29	40.7	5.44
Williamsburg	27	45	1, 6	—12	21.4	4.23	28	54	5	18	37.1	2.78
West Waterville	27, 28	55	6	—12	26.2	5.05	28	62	4	26	42.5	2.73
Gardiner	28	49	1	—17	25.1	4.00	28	61	4	29	42.6	3.05
Standish	27	54	6	—19	24.0	4.39	17, 28	63	4	25	41.9	1.97
Norway	28	55	6	—20	23.3	2.97	27, 28	61	5	25	40.9	3.75
Rumford Point	27	50	6	—24	22.7	3.20	17	62	5	20	41.3	1.05
Cornish	27, 28	54	6	— 8	25.0	4.96	27	64	4	23	41.8	1.81
Cornishville	27	46	5	— 5	24.4	5.76	27, 28	63	5	20	41.5	1.57
Averages	......	......	......	......	23.8	4.68	......	......	......	......	41.1	2.57
NEW HAMPSHIRE.												
Stratford	28	48	1	—22	19.4	3.60	20	67	4	18	37.7	2.48
Shelburne	27	59	2, 6	—24	25.8	2.37	27, 28	64	12	18	40.3	......
North Barnstead	13	48	1	— 1	26.2	2.50	27	67	3	26	44.8	1.22
Goffstown Center	28	56	6	— 1	26.4	3.40	28	74	3, 4, 5	26	42.8	1.50
Averages	......	......	......	......	24.5	2.97	......	......	......	......	41.4	1.73
VERMONT.												
Lunenburg	28	47	2	—23	19.6	4.45	20	60	5	20	38.8	2.05
Barnet	26	58	3	—30	18.9	3.70	......	......	......	......	......	......
North Craftsbury	29	52	1	—17	19.3	2.74	24	58	4	16	37.0	2.48
East Bethel	27	50	1	—27	20.1	5.83	27	68	11	22	40.4	2.00
Woodstock	27	49	1	—27	17.7	......	24	64	1	21	39.7	......
Near St. Albans	29	51	5	—29	18.8	......	20	63	4	20	39.7	......
West Charlotte	27	66	1	—17	26.3	3.64	20	72	4	24	41.4	3.60
Middlebury	27	47	1	—20	22.9	3.33	20	71	1	22	42.8	3.94
Brandon	27	55	1	—14	27.0	3.40	20	72	1	22	42.2	2.27
Averages	......	......	......	......	21.2	3.87	......	......	......	......	40.3	2.72
MASSACHUSETTS.												
Kingston	27	65	2	4	30.5	6.03	24	75	4	28	47.1	1.38
Topsfield	27	57	6	— 8	27.2	6.73	26	68	3	26	44.9	1.49
Lawrence	23	53	6	— 7	28.1	7.43	18	68	3	30	43.3	1.80
Milton	27	64	1	4	32.7	5.17	18, 26	74	3	29	48.6	1.79
Cambridge	27	68	1	0	32.3	......	25	78	4	28	47.6	......

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MASS.—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
North Billerica ..	28	54	2	—11	28. 1	......	27	71	3	27	45. 5	......
West Newton....	27	62	2	— 4	30. 7	3. 56	24	78	4	24	48. 4	......
New Bedford	27	64	5	6	32. 1	5. 98	26	73	4	30	47. 3	1. 32
Worcester	27	55	1, 5	2	28. 3	4. 83	19	71	4	26	45. 7	2. 52
Mendon..........	27	56	5	0	27. 4	4. 10	19	74	3, 4	26	45. 1	2. 81
Lunenburg	28	56	5	— 2	28. 1	5. 52	24, 27	70	4	22	45. 5	3. 95
Amherst.........	27	54	1	— 9	27. 3	4. 46	29	74	4	27	46. 5	1. 53
Richmond	26	58	1, 5	— 5	27. 0	4. 94	26	78	5	20	45. 6	5. 75
Williams College.	28	50	1	— 8	25. 1	4. 44	20	74	3	24	39. 4	3. 16
Hinsdale	26, 28	50	22	— 5	25. 2	5. 72	19, 20, 27	72	3, 4	20	43. 2	3. 40
Averages....	......	......	......	......	28. 7	5. 30	......	......	......	......	45. 6	2. 58
RHODE ISLAND.												
Newport.........	27	60	1, 5	10	33. 3	7. 05	26	68	4	31	46. 7	1. 04
CONNECTICUT.												
Pomfret	27	55	5	0	26. 4	5. 20	......	......	......	......	47. 1	......
Columbia	28	64	1	2	31. 6	......	19	76	4	26	47. 1	......
Middletown......	27	61	1	— 4	29. 4	6. 68	27	78	4	27	47. 1	1. 65
Waterbury	27	55	2	— 4	29. 1	5. 02	24	74	1	29	46. 7	1. 98
Colebrook	28	54	5	— 6	24. 7	4. 68	19, 20	76	4	23	43. 8	1. 73
Brookfield	28	60	2	— 6	31. 6	8. 10	19	81	5	28	47. 5	2. 80
Averages....	......	......	......	......	28. 8	5. 94	......	......	......	......	46. 4	2. 04
NEW YORK.												
Moriches	27	71	5	11	36. 5	8. 32	26	81	4	28	51. 0	3. 42
South Hartford ..	28	58	1	—17	26. 3	5. 75	......	......	......	......	......	......
Garrison's	27	58	1, 5	5	34. 0	6. 58	19	78	4	31	50. 0	1. 95
Throg's Neck....	27	58	5	8	34. 1	......	26	77	3, 4	30	49. 0	......
White Plains	27, 28	58	5	5	33. 6	......	27	74	4	32	48. 0	......
Deaf & Dumb In.	28	62	5	9	34. 1	5. 84	27	76	4	32	50. 1	1. 57
Columbia College.	27	61	5	9	34. 0	3. 98	19	76	4	33	50. 3	1. 39
Flatbush	27	58	5	9	31. 3	4. 30	19	79	4	30	48. 0	1. 56
Nyack	28	72	5	12	37. 3	6. 09	27	79	9	36	51. 9	1. 62
Newburg	27, 28	57	1, 5	4	33. 3	1. 32	26	79	4	30	50. 9	0. 92
Minaville	14	49	1	— 4	24. 7	3. 00	19	80	1, 4	22	43. 5	1. 45
Sloansville	14, 28	50	5	— 4	24. 0	6. 27	19	80	4	18	41. 2	3. 41
Gouverneur......	28, 29	48	1	—12	24. 1	2. 50	20	75	1, 4	18	40. 4	1. 18
North Hammond	28	54	7, 22	— 5	23. 9	1. 96	20	64	1	18	41. 7	0. 95
Houseville	25	50	4, 5, 21, 22	—4	23. 4	4. 46	27	74	1	18	39. 5	2. 69
Leyden	28	47	4	— 5	28. 2	4. 65	27	64	1	16	38. 2	4. 06
South Trenton ...	28	44	22	— 6	21. 9	4. 87	29	68	10	14	38. 1	4. 91
Cazenovia	28	50	22	— 1	25. 9	......	19	76	4	24	42. 4	......
Oneida...........	28	53	22	0	27. 0	3. 45	19	78	1, 3	27	43. 0	4. 34
Depauville.......	28	54	5, 22	0	24. 8	4. 95	20	72	1	18	40. 6	1. 10
Oswego	28	49	22	4	27. 4	4. 10	20	73	1	23	40. 5	2. 09
Palermo	28	48	22	— 3	23. 2	1. 93	20	73	1	20	40. 9	1. 70
North Volney....	28	51	21, 22	4	26. 3	......	......	......	......	......	......	......
Ludlowville......	28	57	6	6	27. 6	......	16	73	4	25	46. 8	......
Waterburg	28	55	22	—10	22. 9	......	19	76	4	22	43. 5	......
Nichols	28	57	22	— 2	29. 0	......	19	80	4	27	46. 2	......
Newark Valley ..	28	54	22	— 8	26. 2	2. 15	19	78	4, 11, 15	24	43. 5	2. 30
Rochester........	26	52	5	3	26. 4	2. 27	20	74	3	25	43. 7	1. 47
Little Genesee ...	28	62	5	—18	25. 7	2. 05	19, 26	74	4	20	42. 2	1. 55
Suspens'n Bridge.	28	52	5	2	26. 2	......	19	75	4	22	41. 2	......
Buffalo	28	64	5	2	27. 7	2. 69	23	70	3, 4	25	41. 3	1. 77
Averages....	......	......	......	......	28. 1	4. 06	......	......	......	......	44. 4	2. 15
NEW JERSEY.												
Paterson.........	27, 28	60	1	1	32. 9	5. 40	24, 27	82	4	29	49. 8	1. 78

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. JERSEY—Con.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Newark	27	63	1	6	34.4	4.67	19	79	4	29	50.5	1.15
New Brunswick	27	60	1	5	33.6	3.74	......	......	......	......	......	......
Trenton	27, 28	64	1	8	39.9	4.79	27	82	4	32	54.4	1.98
Rio Grande	27	66	5	8	37.0	4.88	27	82	4, 12, 14	34	49.2	......
Moorestown	14	68	1	9	36.5	4.63	19	79	4	31	51.6	2.12
Newton	28	60	5	3	31.5	4.89	19	78	4	29	47.8	1.79
New Germanto'n	27	61	1	— 2	37.4	4.24	20	82	5	31	50.3	1.20
Haddonfield	......	......	......	......	......	......	27	80	4	32	51.5	2.00
Newfield	27	66	1	9	36.4	......	27	83	4	30	51.2	......
Greenwich	27	66	5	13	38.4	4.64	27	80	4	32	52.2	1.32
Vineland	27, 28	68	5	9	37.7	3.71	27	90	1, 4	33	53.1	2.57
Averages	......	......	......	......	35.9	4.56	......	......	......	......	51.1	1.77
PENNSYLVANIA.												
Nyces	28	58	22	— 4	28.6	5.21	19, 24, 27	77	1, 4, 12	24	45.8	1.72
Hamlinton	......	......	......	......	......	......	19	78	4	25	43.7	1.88
Dyberry	28	60	5	— 8	25.5	5.15	19	75	15	20	43.6	1.87
Fallsington	27, 28	65	1	6	37.0	5.20	19	79	4	29	48.7	1.40
Philadelphia	27	63	5	14	38.9	5.21	19, 27	79	4	34	53.1	1.82
Germantown	28	65	5	8	36.5	......	20, 27	84	4	29	52.4	......
Horsham	27	65	1	6	36.5	4.57	27	79	4	31	51.3	2.12
Plym'th Meeting	27	63	5	11	36.4	4.62	19	82	4	31	51.2	1.17
White Hall	27, 28	58	1	3	33.9	......	19	80	4	24	49.4	......
Factoryville	28	60	5	0	28.2	3.43	19	78	4	26	44.6	2.57
Reading	27	64	5	13	38.3	......	19, 27	82	4	31	52.9	......
Parkersville	27	64	1	9	36.6	4.35	19	80	4	29	50.8	2.44
West Chester	27, 28	62	5	9	35.8	4.03	19	80	4	29	50.3	2.90
Phenixville	27	61	1	9	37.5	4.25	27	80	12	30	50.7	1.00
Ephrata	27	66	1, 7, 22	14	36.6	4.56	19	84	5, 15	32	54.4	2.82
Silver Spring	14	67	5	10	37.0		......	......	......	......	......	......
Mount Joy	14	69	5	14	39.4	......	19	82	12	29	52.8	......
Harrisburg	27	61	5	13	36.5	4.76	27, 28	76	4	32	50.1	1.68
Carlisle	14	70	5	10	37.9	5.75	19	86	4, 15	32	51.5	1.80
Fountain Dale	14	65	1, 5	13	37.6	4.48	19	78	3, 4, 11	32	51.6	1.77
Tioga	......	......	......	......	......	......	18	76	10	16	38.8	1.95
Williamsport	......	......	......	......	......	......	19	73	4, 5	29	48.3	......
Lewisburg	14	63	5	6	38.2	3.51	19	82	4	28	49.2	2.56
Ickesburg	14	65	5	8	34.9	4.89	19	85	3	29	49.6	2.79
Grampian Hills	28	57	5	—10	25.7	4.57	19, 28	72	3, 4, 15	20	41.6	3.08
Johnstown	28	56	7	8	32.2	......	28	76	14, 15	29	45.0	4.17
Franklin	•28	66	7	0	28.9	4.45	19	74	15	22	45.1	1.57
Connellsville	26, 28	68	7	2	32.9	......	23	81	4	22	47.9	......
New Castle	28	67	16	2	31.3	......	19	76	4	22	48.6	......
Beaver	28	70	16	10	35.6	4.23	28	79	3, 4	32	48.8	1.60
Canonsburg	26	71	7	6	34.7	3.87	26	80	4, 13	24	49.3	0.89
Averages	......	......	......	......	30.9	4.55	......	......	......	......	48.7	2.04
MARYLAND.												
Woodlawn	27	70	5	10	37.3	5.20	28	80	4	30	52.5	1.94
Annapolis	27	68	5	13	42.1	4.36	19, 28	80	12	33	55.4	2.80
St. Inigoes	27, 29	64	5	15	40.7	4.39	20, 27	76	11	32	55.8	3.85
Frederick	14, 27	69	5	15	42.6	......	28	83	5, 12	35	56.3	1.58
Emmittsburg	27	70	5	8	37.7	......	27	84	11	29	52.4	......
Mt. St. Mary's	27	63	5	11	36.9	5.62	27	78	11	31	51.0	2.53
Averages	......	......	......	......	39.6	4.89	......	......	......	......	53.9	2.54
DIST. COLUMBIA.												
Washington	27	65	7	16	40.7	3.23	28	77	11	34	53.8	2.08

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
VIRGINIA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Johnsontown	14	67	7	18	43.2	2.80	27	80	11	35	54.1	1.10
Hampton	14	68	7	18	44.0	3.00	23	86	5	33	56.1	1.50
Zuni Station	14, 29	72	7	19	46.6	2.32	19, 23	82	15	32	57.5	1.65
Bacon's Castle	15, 27	75	7	19	46.9	......	27	91	12	36	58.6	......
Comorn	14, 27	70	5	16	42.1	1.95	23	82	12	33	56.6	2.20
Mt. Solon	14	74	7	10	43.9	3.15	22	82	12	20	53.6	2.25
Staunton	14	67	6, 7	14	40.7	5.06	23	79	12	29	51.8	1.71
Lexington	27	73	1	17	45.0	3.78	23	87	12	32	56.7	3.42
Lynchburg	14	67	7	18	47.6	......	23	77	4	32	55.7	......
Snowville	14, 27	72	7	4	41.5	11.50	23	81	15	22	50.6	7.50
Wytheville	......	......	......	......	......	......	22, 23	80	15	26	55.5	1.29
Near Wytheville	25	76	7	— 1	40.6	3.15	23	78	4, 15	28	51.7	1.95
Averages	......	......	......	......	43.8	4.08	......	......	......	......	45.9	2.13
WEST VIRGINIA.												
Romney	......	......	......	......	......	......	23	90	12, 15	28	51.4	......
White Day	27	70	7	12	30.4	......	......	......	......	......	......	......
Weston	28	71	7	4	37.4	......	......	......	......	......	......	......
Cabell C. H	31	58	6	16	40.2	2.70	20	74	14	28	51.3	1.90
Averages	......	......	......	......	36.0	2.70	......	......	......	......	51.4	1.90
NORTH CAROLINA.												
Kenansville	15	83	7	20	53.3	2.95	23	91	5	32	64.3	5.70
Goldsboro	15, 27	80	7	19	53.0	2.95	27, 28	90	12	34	62.4	1.37
Raleigh	14	80	7	18	48.2	3.70	23	90	13, 15	32	60.3	2.40
Oxford	14	76	1	12	47.7	3.35	27	87	4	32	60.3	1.45
Trinity College	14	73	1, 7	24	46.9	2.80	18	85	14, 15	32	57.6	1.98
Chapel Hill	......	......	......	......	......	......	23, 29	86	12	36	62.8	......
Albemarle	14	78	7	12	48.4	4.75	23	87	15	23	57.7	3.92
Statesville	14	74	1, 7	10	43.8	3.50	23	84	5	24	55.7	3.25
Asheville ....(A)	26, 27	70	7	12	43.9	3.70	22	76	4, 5	30	53.9	3.60
Do ......(H)	26	72	7	8	44.3	......	1, 9, 22, 23, 29	76	4, 15	28	54.2	......
Averages	......	......	......	......	47.7	3.46	......	......	......	......	58.9	2.96
SOUTH CAROLINA.												
Camden	14	74	1	16	51.5	2.36	1, 29	84	5	34	62.4	1.69
Aiken	15, 27	75	1	25	53.3	2.58	9	84	5	34	62.9	5.05
Gowdeysville	14, 15	77	1, 7	20	53.3	2.58	29	88	5	28	59.2	2.21
Averages	......	......	......	......	52.7	2.51	......	......	......	......	61.5	2.98
GEORGIA.												
Berne	......	......	......	......	......	......	24	83	5, 14	38	63.2	4.00
Penfield	15, 31	76	1	22	52.3	2.83	1, 25	84	14	36	61.5	2.75
Macon ....(A)	27, 31	78	1	25	55.4	2.13	26	86	5, 14	36	62.5	4.90
Do.....(W)	30	78	1	23	55.7	2.73	9	87	5, 14	38	64.3	5.52
Atlanta	27, 31	76	1	16	49.7	5.85	23	85	14	29	59.0	8.67
Averages	......	......	......	......	53.3	3.39	......	......	......	......	62.1	5.17
ALABAMA.												
Opelika	......	......	......	......	......	......	25	88	3, 4, 5	42	65.1	......
Carlowville	31	84	1	30	57.7	5.70	25	85	3	40	65.3	10.50
Moulton	31	72	1, 7	22	48.7	3.77	9	79	14	34	60.4	5.55
Green Springs	31	83	1	20	52.7	3.25	10, 22	82	3, 14	33	61.1	8.92
Havana	31	80	1	22	55.0	4.00	25	84	3, 5, 14	38	61.5	8.60
Averages	......	......	......	......	53.5	4.18	......	......	......	......	62.7	8.39

Meteorology of 1869—Continued.

Stations in States and Territories.	March. Date.	March. Maximum temperature.	March. Date.	March. Minimum temperature.	March. Mean temperature.	March. Rain and melted snow.	April. Date.	April. Maximum temperature.	April. Date.	April. Minimum temperature.	April. Mean temperature.	April. Rain and melted snow.
FLORIDA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Port Orange	29	82	1	34	65.5	......	30	91	14	48	68.0	......
Jacksonville	29, 31	84	1	32	62.8	2.40	1	91	5	43	67.5	4.25
Pilatka	30	85	1	32	64.0	3.44	27	96	14	45	68.9	1.84
Ocala	25, 28	87	1	30	69.7	......	30	92	4	41	68.9	......
Manatee	22, 24, 25	86	1	36	70.4	7.50	23	90	14	54	71.6	4.00
Chattahoochee	......	......	......	......	......	......	23	87	14	45	......	......
Averages	......	......	......	......	66.5	4.45	......	......	......	......	69.0	3.36
TEXAS.												
Gilmer	14, 31	87	5	28	58.0	4.14	22	86	3	38	65.1	5.77
Houston	20, 31	84	5	37	62.3	......	18	88	3	48	68.6	......
Columbia	30	88	6	35	64.9	1.92	29	90	3	41	68.5	2.37
Blue Branch	......	......	......	......	......	......	19	87	3	36	65.0	3.31
Lavaca	28	90	15	38	61.4	2.40	19	86	3	47	66.5	3.16
Waco	29	94	15	27	58.9	4.50	19, 22	92	2	45	66.5	5.10
Austin	29	88	15	29	59.9	3.51	19	90	3	45	65.1	3.09
Clinton	......	......	......	......	......	......	19	83	3	47	67.8	3.53
Averages	......	......	......	......	60.9	3.29	......	......	......	......	66.6	3.76
LOUISIANA.												
New Orleans	31	82	5	41	......	......	......	......	......	......	......	......
Shreveport	......	......	......	......	......	4.26	8, 21	82	4	40	65.5	......
MISSISSIPPI.												
Columbus	31	80	1	26	52.5	4.28	22	79	3	39	61.6	11 27
Marion C. H	30, 31	82	1	18	55.3	3.10	25	83	3	30	62.6	12.40
Grenada	31	86	5	24	53.5	5.10	19, 21	84	4	34	63.5	12.20
Near Brookhaven.	31	82	1	28	54.6	6.10	17, 25	84	3	39	64.4	12.00
Natchez	31	77	1	27	57.6	6.89	19	78	3	40	64.3	9.10
Paulding ?	31	85	5	30	57.3	5.88	8	81	14	37	63.9	9.03
Averages	......	......	......	......	55.1	5.23	......	......	......	......	63.4	11.00
TENNESSEE.												
Elizabethtown	14, 27	72	7	6	43.8	2.95	23	86	8	28	55.3	3.25
Tusculum College	27	68	6	16	45.3	1.00	23	80	3, 4	33	55.9	3.50
Lookout Mount'n.	27	72	7	12	46.9	......	22, 23	75	13	32	56.5	......
Clarksville	27	77	5	15	44.4	5.07	9	80	3	31	56.5	5.28
Trenton	31	76	5	20	47.0	5.03	22	83	14	31	60.3	9.00
Memphis	31	82	1, 7	22	47.5	6.37	9	82	4	34	59.8	8.79
Averages	......	......	......	......	45.8	4.08	......	......	......	......	57.4	5.96
KENTUCKY.												
Pine Grove	27	70	7	8	39.0	3.48	18	78	4	28	51.9	5.17
Lexington	28	70	7	9	39.7	4.39	18	78	4	26	51.7	6.16
Danville	27	75	7	10	44.6	3.50	22	82	13	32	56.8	4.35
Louisville	28	75	6	9	40.2	4.66	23	78	4, 14	26	51.7	5.80
Clinton	27	77	5	15	42.4	5.69	22, 23	78	3. 13	33	55.6	5.10
Averages	......	......	......	......	41.2	4.34	......	......	......	......	53.5	5.32
OHIO.												
New Lisbon	28	65	1	— 6	30.4	4.12	......	......	......	......	......	......
Steubenville	28	66	7, 16	10	34.6	2.77	28	75	4	26	51.1	0.79
Martin's Ferry	26	68	1	9	34.9	3.06	28	80	12	26	49.1	1.10
Painesville	28	64	16	10	29.1	4.28	19	71	4	24	44.8	3.53
Gilmore	28	68	1	6	36.0	4.00	28	80	3, 4	28	49.4	1.89
Milnersville	27	64	16	— 1	32.6	3.24	......	......	......	......	......	......

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
OHIO—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Cleveland	28	69	16	3	29.6	3.89	19	76	4	27	45.8	2.65
Wooster	28	70	1, 16	— 4	32.3	2.30	19	76	4, 12	28	52.5	4.80
Smithville	......	......	......	......	......	......	26	75	4	28	49.3	1.30
Gallipolis	27	68	7	7	38.4	2.99	......	......	......	......	......	......
Kelley's Island	28	62	5, 7	8	29.7	2.45	23	68	3, 4	26	45.0	3.22
Sandusky	28	68	7	5	30.1	2.67	19	74	3, 4	27	46.4	3.22
North Fairfield	28	71	7	0	31.3	3.50	19	74	3, 4	26	48.9	1.79
Carson	28	68	7	4	31.3	......	19	71	4	28	47.9	1.53
Westerville	28	72	6	7	33.8	4.59	28	75	3, 4	30	49.3	1.96
New Holland	29	68	6	4	36.0	8.76	23	83	14	23	56.1	7.11
Marion	28	67	7	— 1	30.3	4.65	19, 23	70	4	25	46.8	1.24
Hillsboro	28	67	6	4	34.3	4.14	18	73	4	25	46.8	3.55
Toledo	29	58	5, 17	4	28.3	3.63	23	78	3, 4	22	45.8	4.99
Bowling Green	28	73	16	— 5	29.9	2.54	19, 23	81	4	26	47.9	4.72
Kenton	......	......	......	......	......	......	17	70	4	32	52.1	4.03
Urbana	28	71	5	3	32.0	5.73	28	77	4	26	48.4	2.43
Bethel	28	67	6	3	34.7	3.50	28	76	4	20	49.6	3.50
Jacksonburg	28	68	6	1	34.4	6.82	27	74	4	26	49.7	4.00
Mt. Auburn	28	71	5	9	38.0	5.84	18	77	3	27	52.8	3.38
Cincinnati...(H)	28	70	6	5	34.0	5.06	18, 28	78	3	27	50.9	2.87
Do. .... (P)	28	72	6	10	41.3	5.14	23	81	3, 4, 15	32	55.0	0.93
College Hill	29	70	6	2	35.8	8.38	18	80	3, 4, 14	28	48.3	2.89
Averages	......	......	......	......	33.2	4.32	......	......	......	......	49.2	2.93
MICHIGAN.												
Monroe City	29	60	5	0	28.8	3.20	19	74	3	28	46.6	2.59
Alpena	27	43	4	— 4	23.9	1.12	25	52	4	20	36.1	2.18
State Ag. College	28, 29	62	11	— 2	27.6	2.55	19	78	3	20	45.7	3.77
Litchfield	28	63	6	— 2	26.1	2.22	23	74	1	12	44.5	4.52
Cold Water	28	63	8	—18	......	......	19	76	3	20	43.6	2.13
Old Mission	......	......	......	......	......	......	15	65	1, 2, 3	22	37.7	1.02
Grand Rapids	29	66	7	4	29.1	......	19	74	3	21	44.9	......
Northport	25	52	4	— 2	24.5	......	27	64	2	22	37.9	4.48
Homestead	25	59	6	0	25.8	......	......	......	......	......	......	......
Pleasanton	29	61	4	— 1	24.0	2.20	26	68	1, 3	20	38.9	4.70
Muskegon	29	64	4	6	30.1	......	19	68	2	26	45.6	2.25
Otsego	29	70	6	6	31.6	......	22, 28	72	1, 2	26	46.3	......
Copper Falls	25	53	4	—13	17.1	2.15	26	66	1	14	32.0	2.83
Penn Mine	26	59	4	—10	19.8	......	26	72	1	13	34.6	......
Ontonagon	26, 27, 28	56	11	—12	21.1	......	25, 26	60	1, 2	24	37.8	......
Averages	......	......	......	......	25.3	2.24	......	......	......	......	40.4	3.05
INDIANA.												
Aurora	28	72	6	2	34.6	5.59	18, 23	81	4	26	50.2	3.97
Vevay	27	71	5	6	37.9	5.40	18	76	4, 14	30	51.3	3.94
Muncie	28	76	6	1	32.9	4.50	23	80	4	24	49.3	4.10
Spiceland	28	71	6	0	33.3	5.13	23	76	4	27	48.0	3.80
New Albany	27	81	6	5	39.9	2.56	......	......	......	......	......	......
Columbia City	28	78	12	0	30.0	......	23	78	2	23	45.4	5.09
Jalapa	28	75	6	5	32.8	3.66	......	......	......	......	......	......
Knightstown	28	71	6	— 1	33.3	4.09	23	75	4	26	51.1	3.91
Indianapolis	28	66	6	0	33.2	4.57	23	76	3, 4	23	48.9	4.46
Bloomington	27	66	6	2	35.5	6.29	23	74	4	29	49.7	4.17
Cannelton	......	......	......	......	......	......	8	83	2	33	58.8	3.56
Lafayette	27, 28	66	6	— 2	31.9	4.50	18	74	2, 3, 4	26	48.0	5.10
Merom	27, 28	68	6	0	35.7	4.08	23	77	4	28	49.4	2.72
Kentland	29	66	17	— 5	31.7	3.85	23	73	2, 3	23	47.7	......
New Harmony	27	73	6	7	39.5	5.05	18, 22, 23	78	2	34	55.0	3.51
Harveysburg	27	72	6	0	34.8	3.90	18	80	2	28	47.7	6.30
Averages	......	......	......	......	34.5	4.47	......	......	......	......	50.1	4.20

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	MARCH. Maximum temperature.	MARCH. Date.	MARCH. Minimum temperature.	MARCH. Mean temperature.	MARCH. Rain and melted snow.	APRIL. Date.	APRIL. Maximum temperature.	APRIL. Date.	APRIL. Minimum temperature.	APRIL. Mean temperature.	APRIL. Rain and melted snow.
ILLINOIS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Chicago	30	68	6	3	32. 4	1. 33	17	72	2	25	37. 8	4. 30
Near Chicago	29	66	16	— 4	27. 4	......	19, 27	70	2	22	43. 4	......
Evanston	29	60	6	3	30. 6	2. 07	19	70	2	25	45. 6	3. 62
Marengo	27	58	5, 6	0	29. 3	......	......	......	......	......	......	......
King's Mills	29	60	6	— 4	26. 3	0. 69	22	68	3	12	43. 0	4. 33
Louisville	27, 29	72	6	5	37. 8	8. 25	23	80	3, 4	30	53. 7	10. 90
Golconda	27	83	6	10	50. 9	9. 40	22	89	6	18	55. 5	3. 80
Belvidere	27	60	6	— 4	27. 7	1. 76	18, 22	68	2, 4	20	44. 5	2. 43
Sandwich	27	•60	6	— 5	27. 8	0. 93	18	74	2, 3	21	44. 8	4. 53
Ottawa	27	65	5	6	33. 5	1. 38	18, 22	75	14	14	48. 5	4. 08
Winnebago	29	62	6	— 5	27. 8	0. 95	22	68	2	20	43. 6	2. 76
Rochelle	27	60	6	— 6	28. 4	......	22	71	2	16	35. 1	......
Wyanet	27	65	6	— 5	30. 5	1. 15	28	70	2	21	47. 1	3. 03
Tiskilwa	27, 30	60	6	— 3	30. 8	......	22	74	2	22	46. 5	......
Hennepin	27	66	6	— 1	31. 0	......	22	78	2	22	45. 0	......
Elmira	27	62	6, 16	— 7	27. 8	1. 64	22	77	2	21	46. 1	2. 07
Peoria	27	69	6	— 3	31. 6	1. 61	28	72	2	25	48. 9	3. 59
Springfield	27	74	6	— 2	34. 6	......	18, 28	82	2	26	50. 2	......
Loami	27	74	6	— 3	33. 6	1. 90	18	83	2, 3	26	50. 5	6. 75
Dubois	27	76	5	— 6	37. 7	4. 61	23, 27	80	4	25	47. 9	4. 89
Waterloo	27	74	6	6	40. 8	2. 80	18, 23, 27	80	2, 4, 13	32	56. 7	3. 65
South Pass	27	76	5, 6	6	39. 8	......	23	83	2, 3	31	56. 3	......
Galesburg	28	66	6	— 6	30. 0	1. 30	22	77	2	25	49. 0	1. 01
Manchester	27	74	6	— 2	34. 1	2. 43	18	85	2	27	51. 3	4. 25
Mt. Sterling	27	72	6	— 4	32. 2	......	22	80	2	26	49. 8	......
Andalusia	30	66	6	— 5	31. 9	......	17, 28	68	13	27	46. 9	......
Augusta	28	67	6	— 5	32. 6	0. 95	18	81	3	24	50. 6	4. 49
Warsaw	27	75	6	— 6	32. 1	1. 56	18	80	2	26	50. 2	4. 80
Averages	......	......	......	......	32. 5	2. 46	......	......	......	......	47. 7	4. 18
WISCONSIN.												
Manitowoc	28	53	4	— 6	26. 2	0. 75	25	67	3	20	40. 4	4. 07
Plymouth	29	59	4	— 8	24. 6	0. 70	15, 17	68	3	14	40. 1	3. 40
Hingham	29	58	4	— 5	25. 4	......	25	69	3	15	39. 9	......
Milwaukee	29	62	4, 6	— 1	27. 7	1. 17	17	69	3	17	41. 8	3. 90
Appleton	29	57	4	— 5	27. 6	......	17, 26, 28	62	1, 3	22	41. 5	......
Geneva	......	......	......	......	......	......	28	70	5	20	43. 2	3. 69
Waupacca	29	60	4, 6	—10	27. 2	......	25	70	1	20	42. 3	......
Embarrass	28	59	11	—14	24. 3	......	25	66	4	11	39. 2	......
Rocky Run	29	62	6	— 8	26. 9	1. 13	17	66	3	18	42. 9	4. 38
Madison	29	59	4	— 8	25. 5	0. 79	17	63	2	13	36. 7	3. 08
Edgerton	23	60	4	— 7	23. 4	......	25	70	2	16	44. 4	3. 00
Baraboo	29	62	4	— 6	26. 3	1. 75	17	70	3	16	43. 0	6. 38
New Lisbon	29	66	4	—15	25. 0	......	25	70	3	20	44. 5	......
Bayfield	28	58	4	—14	19. 2	......	25	74	2	16	35. 7	......
Averages	......	......	......	......	25. 3	1. 05	......	......	......	......	41. 1	3. 99
MINNESOTA.												
Beaver Bay	30	58	4	—18	22. 1	1. 01	25	74	3	15	37. 5	1. 70
Afton	28	54	4	—20	20. 7	0. 47	25	69	2, 3	12	40. 5	1. 00
St. Paul	28	55	4	—18	21. 3	0. 96	25	68	2	13	41. 0	0. 56
Minneapolis	28	54	4	—23	20. 3	0. 96	25	69	2	12	40. 5	1. 31
Sibley	25, 28	49	4	—26	18. 3	0. 95	17, 28	64	2	7	40. 0	1. 05
Koniska	25	45	4	—26	17. 5	2. 15	25	64	2	10	41. 6	2. 46
New Ulm	28	49	6	—20	19. 7	0. 90	17	68	2	17	42. 6	0. 73
Madelia	28	50	4, 6	—24	17. 7	1. 05	22	70	2, 3	12	42. 2	1. 73
Averages	......	......	......	......	19. 7	1. 06	......	......	......	......	40. 7	1. 32
IOWA.												
Clinton	27	65	6	— 8	28. 9	1. 75	22	73	2	20	45. 7	4. 16
Davenport	27, 28	61	6	— 7	28. 5	1. 51	18, 22	73	1, 2	24	44. 8	5. 25
Waukon	......	......	......	......	......	......	17	67	2	14	42. 2	......

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
IOWA—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Dubuque	28, 29	62	4	— 5	29. 1	0. 89	18, 22	69	2	19	45. 8	2. 75
Monticello	28	65	6	—10	28. 2	......	22	73	1	22	45. 4	1. 90
Bowen's Prairie	27	66	6	—12	27. 4	0. 45	22	76	2	18	44. 7	3. 77
Fort Madison	27	68	4, 6, 16	— 3	32. 0	1. 68	18, 22	80	4	23	48. 3	3. 36
Guttenberg	27, 28	62	6, 16	—10	26. 3	......	17, 22	70	2, 3	16	43. 2	......
Mt. Vernon	27, 29	66	4, 6	— 8	27. 9	......	22	76	2	21	45. 7	......
Iowa City	28	72	6	—12	30. 3	0. 59	18	80	2	20	47. 1	3. 20
Independence	27	63	6	—14	25. 6	1. 30	18	76	2	17	44. 5	2. 60
Near Indepen'ce	27	64	6	—17	24. 6	2. 05	18	78	2	16	43. 1	3. 90
Waterloo	29	66	6	—14	26. 2	......	22	73	2	16	40. 6	......
Rockford	27	62	6	—14	24. 6	0. 50	18	74	2	14	45. 6	......
Iowa Falls	27	66	4	—12	26. 8	0. 83	18	76	2	20	42. 7	3. 05
Algona	28	56	4, 6	—16	22. 2	......	18	72	2	24	42. 3	......
West Bend	28	49	4	—18	19. 5	......	18	72	2	17	42. 0	......
Fort Dodge	28	64	6	—16	23. 3	0. 18	......	......	......	......	......	......
Mineral Ridge	......	......	......	......	......	......	18	77	1,2,3,12	26	45. 1	2. 45
Fontanelle	27, 28	68	6	—12	30. 7	0. 31	17	81	2	24	46. 9	2. 33
Rolfe	28	57	6	—21	21. 9	0. 43	18	77	2	19	45. 4	1. 13
Grant City	28	68	6	—15	26. 4	0. 43	18	82	2	20	45. 8	1. 58
Logan	28	66	6	— 8	31. 5	0. 50	18	76	2	14	45. 1	1. 10
Woodbine	28	67	6	— 8	20. 5	......	18	79	2	20	44. 9	......
Averages	......	......	......	......	26. 5	0. 89	......	......	......	......	44. 6	2. 84
MISSOURI.												
St. Louis Univ'ty	27	75	6	7	39. 8	2. 73	18, 22	80	2	31	55. 0	2. 87
Allenton	27	84	5, 6	5	39. 1	[illegible]. 21	18, 22	85	4	26	54. 3	6. 08
Hematite	27	81	5	5	40. 9	5. 90	18	82	4	24	55. 7	2. 80
Rolla	27	82	6	10	40. 9	3. 24	18	85	4	23	53. 5	4. 31
Jefferson City	27	80	6	6	40. 0	......	18, 22	80	2, 3	30	54. 0	......
Hermitage	31	78	6, 15	6	38. 8	2. 91	8, 18	82	3	29	52. 9	1. 88
Bolivar	27, 31	77	15	7	41. 8	4. 90	9, 18	82	2	32	57. 9	3. 65
Warrensburg	27, 28	76	6, 15	0	39. 9	2. 22	18	83	1, 3	32	54. 2	2. 60
Harrisonville	31	78	15	0	37. 8	1. 35	8	80	2	26	52. 4	4. 72
St. Joseph	27, 28	70	15	6	39. 2	1. 04	18	84	1, 3	33	56. 0	4. 00
Oregon	28	69	15	3	36. 2	1. 28	18	82	3	21	49. 6	3. 31
Averages	......	......	......	......	39. 5	2. 98	......	......	......	......	54. 1	3. 62
KANSAS.												
Atchison	27, 31	70	15	— 2	36. 0	0. 95	18	84	3	23	51. 7	4. 20
Leavenworth	31	80	15	— 2	35. 7	1. 03	18	90	2	19	51. 5	3. 54
Olathe	......	......	......	......	......	......	18	84	2	25	51. 0	5. 00
Baxter Spring	31	82	15	6	43. 0	2. 85	18	86	2	32	58. 2	2. 60
Lawrence	31	80	15	0	35. 1	1. 15	18	83	2	22	49. 4	2. 43
Holton	31	80	15	— 2	37. 0	......	21	80	3	23	51. 2	......
Le Roy	31	76	15	2	38. 9	1. 42	9, 18	90	13	20	55. 2	2. 60
Neosho Falls	31	82	15	1	36. 8	1. 90	8, 18	84	2	23	52. 0	1. 70
State Agr. College	31	72	15	— 2	35. 7	1. 06	18, 21	77	2	22	47. 4	2. 20
Council Grove	31	80	15	1	39. 6	1. 85	18	89	2, 4	26	53. 3	4. 4
Averages	......	......	......	......	37. 5	1. 53	......	......	......	......	52. 1	3. 19
NEBRASKA.												
Dakota	28	68	6	— 8	31. 6	......	17, 22	74	3	24	45. 5	......
Omaha Mission	27	68	6	— 5	33. 7	0. 30	16, 17	70	2	19	49. 2	2. 90
Elkhorn	28	68	6	— 4	32. 0	......	14	76	2	19	47. 3	......
De Soto	28	66	6	— 9	31. 3	0. 28	18	76	2	19	46. 2	1. 64
Fontanelle	......	......	......	......	......	......	18	85	1	22	47. 5	......
Bellevue	28	69	6	0	34. 8	......	14	81	2	25	50. 3	1. 70
Glendale	28	70	6	— 5	32. 6	0. 60	14	80	2, 3	25	50. 2	2. 45
Nebraska City	27, 28	70	6	— 2	40. 8	1. 05	8	77	2, 3	28	53. 3	3. 05
Peru	28	69	6	— 4	33. 3	......	......	......	......	......	......	......
Decatur	28	60	6	— 2	32. 6	0. 63	14	79	1	24	47. 3	1. 09
Averages	......	......	......	......	27. 5	0. 57	......	......	......	......	48. 5	2. 14

Meteorology of 1869—Continued.

Stations in States and Territories.	MARCH. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	APRIL. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
UTAH TERRITORY.												
		Deg.		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Coalville	12	56	1	15	36.9	......	13	63	2	23	43.1	......
CALIFORNIA.												
Monterey	10, 16	71	31	40	56.1	2.69	27	73	1	40	58.0	0.94
Murphy's	11	72	31	28	50.0	6.13	......	......	......	......	......	......
Paradise City	9	73	4	37	54.1	3.54	......	......	......	......	......	......
Watsonville	9	80	4	40	50.4	5.80	12, 23	83	22	42	61.4	2.30
Averages	......	......	......	......	54.9	4.54	......	......	......	......	59.7	1.62
MONTANA TER.												
Fort Benton	22	76	4	6	38.6	1.35	30	81	3	28	53.1	2.95
Deer Lodge City	24	54	15	—12	29.0	2.50	30	68	1	16	42.6	......
Averages	......	......	......	......	33.8	1.93	......	......	......	......	47.9	2.95
WASHINGTON TER.												
Port Angeles	......	......	......	......	......	......	6, 8	58	8	45	51.0	5.64

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MAINE.												
Houlton	25	84	1	26	54.5	4.20	4	87	7	46	64.5	......
Steuben	26	73	1	33	49.4	3.65	3	79	8	44	58.0	3.74
Williamsburg	25	80	1	28	50.1	2.95	4, 5	82	7	48	60.0	4.72
West Waterville	25	83	4	34	54.2	4.66	3	84	7	51	63.3	4.40
Gardiner	26	73	2	37	53.0	4.52	3	77	9	49	61.3	5.50
Standish	12	83	2	34	54.7	6.99	4	84	7, 9	48	63.9	2.54
Norway	25	84	2	34	53.6	4.65	3	84	12	48	62.1	4.47
Cornish	25	83	1, 2	34	53.8	4.09	3	84	7	48	62.2	2.98
Cornishville	12, 25	84	2	34	55.7	5.11	3, 4	84	7	50	64.9	2.99
Averages	......	......	......	......	53.2	4.54	......	......	......	......	62.2	3.92
NEW HAMPSHIRE.												
Stratford	31	83	1	32	52.0	3.97	4	86	9	41	59.9	4.39
Whitefield	25	84	22	41	58.0	......	3	84	9	40	62.2	......
Shelburne	12	90	1	17	51.1	......	......	......	......	......	......	......
North Barnstead	12	85	2	33	55.2	3.19	3	82	6, 7, 9	50	63.5	2.29
Concord	12	88	1	34	56.4	......	......	......	......	......	......	......
Goffstown Center	12	87	1, 2	32	53.0	3.40	4	88	7	42	63.0	3.10
Averages	......	......	......	......	54.3	3.52	......	......	......	......	62.2	3.26
VERMONT.												
Lunenburg	31	78	1, 3, 4	34	55.1	2.85	4	84	6	46	61.8	5.00
North Craftsbury	11	78	2	31	51.0	2.77	4	83	6	40	59.3	6.55
East Bethel	25	86	6	36	54.8	3.43	4	91	7	41	63.8	4.50
Woodstock	12	85	1, 2	33	52.5	......	4	81	7	40	59.8	2.85
Near St. Albans	25	79	3	30	53.2	......	4	83	6	45	62.2	......
West Charlotte	25	84	1	32	55.9	6.34	29	89	7	37	65.2	7.47
Middlebury	12	78	2	35	54.4	4.31	4	77	7, 9	48	62.6	3.38
Panton	25	80	3	36	54.6	5.42	4	84	6, 8, 10	50	63.9	5.19
Brandon	25	88	2, 3	34	55.9	3.99	4	88	7	42	63.6	3.53
Averages	......	......	......	......	54.2	4.16	......	......	......	......	62.5	4.81

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MASSACHUSETTS.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Kingston	25, 26	88	2, 6	38	55. 3	4. 24	1, 29	86	7, 10	50	64. 2	5. 87
Topsfield	12	87	7	36	54. 9	4. 85	29	82	7	46	63. 9	4. 01
Milton	12, 26	87	2	39	54. 4	3. 31	29	87	8	51	66. 2	3. 65
Cambridge	12, 25	89	1	37	57. 5	......	4	90	7	49	66. 4	......
North Billerica	26	87	2	38	56. 7	......	3	85	7	49	67. 7	......
West Newton	12	96	4	38	58. 0	......	29	91	6, 7, 8, 9	52	69. 9	2. 92
New Bedford	26	82	1, 2	41	55. 5	5. 69	19, 29	87	7, 8	52	65. 5	4. 27
Worcester	12, 26	80	4	33	56. 0	5. 77	29	80	7	50	64. 7	3. 08
Mendon	26	85	1	30	55. 5	4. 70	3	80	8	50	64. 5	5. 20
Lunenburg	12	87	2	34	56. 3	9. 30	3, 29	84	7	49	65. 7	7. 35
Amherst	12	83	2	35	55. 9	5. 65	29	81	8	47	64. 7	5. 99
Richmond	24	87	3, 4, 5	34	57. 9	7. 85	4	90	10	38	64. 1	11. 24
Williams College	12	86	2	33	54. 2	3. 28	4	84	9	45	62. 8	3. 84
Hinsdale	12	84	2	31	54. 2	3. 75	3, 4	80	8	42	62. 7	7. 15
Averages	......	......	......	......	55. 9	5. 31	......	......	......	......	65. 2	5. 40
CONNECTICUT.												
Columbia	26, 31	86	1, 2	36	57. 9	......	1	88	8	46	66. 4	......
Middletown	26	85	1	37	56. 4	5. 90	28, 29	85	9	48	66. 2	4. 78
Waterbury	26	81	1	35	56. 0	5. 45	28, 29	80	8, 10	48	65. 3	4. 10
Colebrook	12	84	1, 2	33	54. 0	5. 38	28	82	7, 11	47	63. 5	10. 95
Brookfield	11, 25, 26	80	6	38	57. 1	6. 00	......	......	......	......	......	......
Averages			......	......	56. 3	5. 68	......	......	......	......	65. 4	6. 61
NEW YORK.												
Moriches	26	85	2	42	58. 6	7. 82	29	92	9	54	70. 0	6. 22
South Hartford	12	84	2, 3	36	57. 9	2. 10	4	82	9	43	67. 1	5. 05
Hudson	......	......	......	......	......	......	1, 4, 18	85	7	52	68. 4	3. 72
Garrison's	26	86	1, 2	39	54. 1	5. 00	28	88	7, 8, 9	50	64. 7	1. 47
Throg's Neck	25	85	1, 2	40	57. 5	......	3, 27	88	7, 8, 9, 11	54	69. 0	......
White Plains	26	83	1	29	57. 0	......	23, 24	85	9	51	67. 8	......
Deaf & Dumb Inst	26	82	1	39	57. 8	5. 45	28	89	8	52	69. 1	4. 72
Columbia College	26	85	1, 2	41	58. 8	3. 32	28	89	9	51	69. 4	3. 31
Flatbush	26	85	2	36	56. 2	3. 61	28	89	10	52	69. 8	6. 46
Nyack	25	83	3	43	60. 0	4. 42	......	......	......	......	......	......
Glasco	......	......	......	......	......	......	29	87	6	45	67. 1	4. 83
Newburgh	31	90	2	38	59. 5	4. 33	28	87	8	53	69. 4	2. 85
Minaville	12	88	2, 3	35	57. 0	3. 05	4	85	8	50	66. 1	4. 40
Gouverneur	11	77	1	32	49. 9	4. 10	3	82	6	47	60. 9	3. 81
North Hammond	12	80	4	34	56. 5	3. 85	3, 29	80	6	47	64. 9	3. 10
Houseville	12	86	1	32	51. 8	3. 59	{ 3, 4, 18, 29 }	80	6, 8	44	60. 9	3. 39
Leyden	12	82	3, 4	30	49. 8	3. 81	3	76	6	42	58. 4	5. 31
South Trenton	12	86	21	33	50. 3	3. 71	3, 23	82	8, 12	40	62. 2	6. 46
Cazenovia	12	83	3, 4	33	52. 2	......	3, 18	81	6	42	61. 9	......
Oneida	12	87	3	26	56. 0	5. 69	18	84	6	44	63. 0	9. 66
Depauville	12	80	4	33	51. 7	4. 08	4	78	6	46	59. 4	3. 09
Oswego	13	77	4	35	50. 5	2. 08	4	79	6	43	59. 6	3. 92
Palermo	12	86	3	35	53. 8	3. 10	3, 4	84	6	44	62. 7	3. 00
North Volney	12	83	2, 3, 4	35	53. 6	......	3, 18	84	6	45	63. 5	......
Ludlowville	12	88	4	38	56. 5	......	18	90	7	42	65. 4	......
Waterbury	12	86	3	32	53. 8	......	29	88	6	44	64. 7	......
Nichols	11	87	2	37	55. 7	......	18	90	7	43	66. 6	......
Newark Valley	12	89	3	34	54. 4	3. 50	18, 20	88	7	42	64. 9	3. 00
Himrods	11	82	2	32	53. 0	4. 50	18	83	6	46	64. 0	3. 94
Rochester	12	82	2	36	54. 9	2. 56	18	81	6	47	63. 2	6. 62
Little Genesee	11, 12	85	5	36	53. 5	2. 95	20	87	7, 8	42	63. 6	4. 32
Suspension B'dge	12	89	2	34	52. 6	......	4	86	6	39	61. 7	......
Buffalo	12	82	2, 3, 4	38	52. 9	2. 18	3	83	6	45	62. 0	5. 19
Averages	......	......	......	......	54. 8	3. 86	......	......	......	......	64. 7	4. 50
NEW JERSEY.												
Paterson	26	90	2	40	58. 7	5. 10	21, 28	90	11	52	69. 8	4. 90

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. JERSEY—Con'd		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Newark	26	84	2	38	57.4	4.67	28	87	10	47	68.4	5.85
New Brunswick	26	83	2	39	53.8	4.76	......	......	......	......	......	......
Trenton	26	89	2	42	62.1	7.00	20, 28	90	9	52	73.4	3.59
Rio Grande	26	97	8	40	58.1	6.38	27	98	8	50	71.3	4.38
Moorestown	26	85	2	36	58.1	4.65	20, 27	88	9	50	70.2	4.95
Newton	26, 31	83	2	36	56.4	3.57	27	84	7	48	65.6	3.48
New Germantown	26	87	2	38	58.0	4.35	28	91	10	51	69.0	4.76
White House	26	81	4	44	62.0	......	19	87	10	50	71.8	......
Haddonfield	31	85	2	42	58.8	3.97	20	89	9	52	70.7	2.93
Newfield	31	91	1, 2, 6	43	60.0	......	20, 21 25, 28	95	9	51	72.8	......
Greenwich	31	85	2	43	59.0	4.39	28	89	9	54	71.8	4.19
Vineland	31	94	2	44	60.7	4.39	26, 28	98	9	53	75.1	4.66
Averages	......	......	......	......	59.0	4.84	......	......	......	......	70.8	4.37
PENNSYLVANIA.												
Nyces	25, 26	85	2	32	56.1	5.10	28	93	6	42	66.2	4.30
Hamlinton	31	79	2	24	55.6	6.29	18	87	6	46	66.1	4.76
Dyberry	12	83	6	34	52.5	2.22	28	84	9	41	63.3	2.50
Fallsington	26	86	2	40	59.7	6.70	27	89	9	54	70.0	4.80
Philadelphia	26	88	2	38	60.4	3.70	20, 28	90	8, 9	56	73.3	4.93
Germantown	31	93	1	40	61.6	......	20	95	7, 9	50	73.6	......
Horsham	26, 31	83	2	40	58.7	4.90	20	88	10	53	69.7	5.90
Plymouth Meet'g.	26	86	2	36	58.7	4.22	20, 28	87	9	53	70.3	4.37
White Hall	12	84	6	36	57.8	......	28	87	9	46	68.1	......
Factoryville	26	85	3	34	54.3	4.15	20	86	9	46	65.6	2.92
Reading	26	89	2	41	58.8	......	20, 28	89	7	50	69.3	......
Parkersville	31	88	5	40	59.1	3.97	27	91	8, 10	55	71.9	3.86
Westchester	26	87	2	40	58.5	4.53	20	92	9	52	70.5	3.59
Phenixville	26	88	2	39	58.7	4.20	20	90	9	50	70.6	6.00
Ephrata	31	90	4	39	62.3	4.16	26	98	8	56	75.3	3.24
Silver Spring	31	90	2	38	60.0	......	......	......	......	......	......	......
Mount Joy	30, 31	86	5	41	59.7	......	20, 28	93	9	48	70.4	......
Harrisburg	26	87	2	41	60.6	4.04	27	90	9	55	72.2	5.46
Carlisle	12, 31	90	2	41	60.6	5.50	20	92	9	52	70.6	6.00
Fountain Dale	31	84	2	40	58.4	4.40	20, 27	89	11	50	69.3	3.03
Tioga	12, 27	84	8	30	50.3	4.50	4, 27	86	7, 10	36	61.6	4.52
Williamsport	31	80	5	40	58.8	......	20	84	9	47	68.6	......
Lewisburg	26	85	2	40	57.6	4.07	26	89	9	51	68.4	4.53
Grampian Hills	26	82	3	33	51.7	5.18	20	85	8	42	63.5	7.28
Johnstown	31	86	3	30	53.0	8.34	20	86	8, 9	40	65.6	11.11
Franklin	12	86	5	36	56.7	5.08	27	87	7	39	66.1	5.10
Connellsville	12	86	2, 3	38	58.1	......	20, 27	86	8	44	67.6	......
New Castle	31	81	3	34	60.1	......	27	85	7	39	68.3	......
Beaver	11, 12, 29	82	2	43	59.3	4.40	19	87	6, 9	52	67.0	5.50
Canonsburg	11, 25	84	2, 3	42	59.0	5.67	19, 20, 27	87	9	44	68.0	2.84
Averages	......	......	......	......	57.9	4.79	......	......	......	......	68.7	4.84
DELAWARE.												
Milford	......	......	......	......	......	......	28	98	9	52	78.2	1.40
MARYLAND.												
Woodlawn	26	92	2	40	59.8	5.08	21, 28	90	9	52	71.6	2.35
Annapolis	31	90	2	45	62.6	5.57	28	95	9	57	75.3	2.89
St. Inigoes	......	......	......	......	......	......	27	94	6, 8	54	72.9	4.00
Frederick	31	86	2	46	65.4	3.69	......	......	......	......	......	......
Mt. St. Marys	31	82	2	41	58.4	5.37	27	88	6, 11	50	68.2	2.22
Averages	......	......	......	......	61.6	4.93	......	......	......	......	72.0	2.87
DIST. COLUMBIA.												
Washington	30	86	2	45	61.1	4.65	20	89	7	58	73.3	3.04

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
VIRGINIA.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Johnsontown	30	87	7, 8	47	56.8	4.70	20, 21, 28, 30	91	9	57	73.8	3.80
Hampton	29	96	7	47	63.8	4.70	21,27,28	94	6, 9, 10	60	76.8	2.80
Zuñi Station	30	94	8	46	63.6	5.35	28	96	12	56	76.8	3.73
Bacon's Castle	31	96	7	47	65.8	......	28	100	10	60	79.8	......
Comorn	31	90	2, 7	46	62.7	3.44	27, 28	90	9	57	74.4	3.05
Staunton	27,30,31	84	7	39	60.5	4.07	29	90	7	58	72.2	1.40
Lexington	27, 31	92	7	43	62.6	4.94	20	96	8	52	73.9	2.60
Lynchburg	30	84	7	46	59.9	......	20	88	8	55	73.2	......
Snowville	29	89	10	39	58.0	17.40	28	90	12	48	66.9	12.50
Wytheville	29	85	3	41	58.9	4.02	25	87	7	51	68.9	2.88
Near Wytheville	27	84	9	40	57.0	4.40	8	90	6	53	68.0	2.00
Averages	......	......	......	......	60.9	5.89	......	......	......	......	73.2	3.86
WEST VIRGINIA.												
Romney	31	94	2, 3, 7, 8	42	62.5	......	19	96	9	48	73.1	......
Weston	......	......	......	......	......	......	3, 22	87	7	45	69.1	......
Cabell C. H.	26	79	2	38	58.2	2.00	19, 29	91	7	40	68.2	5.30
Averages	......	......	......	......	60.4	2.00	......	......	......	......	70.1	5.30
NORTH CAROLINA.												
Kenansville	26	94	8	41	68.2	6.15	......	......	......	......	......	......
Goldsboro	31	96	3, 8	48	68.1	4.22	21, 22	101	7, 8, 9	66	81.2	6.00
Raleigh	31	97	6, 8	48	64.7	3.80	21, 22, 23, 25	98	2, 8, 10, 11	60	79.1	......
Oxford	29,30,31	94	3	48	66.8	4.00	21	97	7	60	78.5	3.35
Trinity College	29	92	7	42	67.2	6.99	......	......	......	......	......	......
Chapel Hill	27, 29, 30, 31	92	3, 7	49	67.4	......	28	96	11, 14	64	77.5	......
Albemarle	27	93	4	32	61.9	3.51	29	97	16	52	74.6	4.78
Statesville	27,29,30	90	3, 4, 8	36	55.4	4.13	20, 21, 25, 26, 27, 28, 29, 30	90	8, 11, 12	50	71.3	9.00
Asheville (A)	26	83	2	43	60.0	3.85	20	85	16, 18	57	68.5	6.40
Do (H)	11,26,30	78	8	33	58.7	......	19, 20, 28, 30	80	16	50	67.1	......
Averages	......	......	......	......	63.8	4.58	......	......	......	......	74.7	5.91
SOUTH CAROLINA.												
Aiken	31	91	3	48	67.8	1.19	30	94	15, 16	64	77.4	3.72
Gowdeysville	29	89	20	50	68.0	3.57	29, 30	91	11, 12	65	77.8	4.25
Averages	......	......	......	......	67.9	2.38	......	......	......	......	77.6	3.99
GEORGIA.												
Berne	31	95	2	53	70.0	2.21	20	92	15	65	76.6	......
Penfield	30, 31	90	2	51	67.4	3.12	30	94	16	62	77.0	2.61
Macon	29,30,31	89	8, 9	51	67.5	3.60	22	98	16	64	75.0	3.58
Atlanta	29	94	3, 4	44	64.0	1.75	1, 21	93	12	52	73.3	2.48
Averages	......	......	......	......	67.2	2.67	......	......	......	......	75.5	2.89
ALABAMA.												
Opelika	29	92	8	52	69.0	1.81	30	96	15	63	79.0	4.69
Carlowville	31	95	3	54	72.6	1.36	21, 22	94	6, 14, 15, 16	70	74.2	3.54
Moulton	5, 7, 28, 29, 30	82	2, 8	48	65.9	2.86	20	89	7	53	72.2	2.63
Green Springs	31	89	9	47	68.1	0.97	......	......	......	......	76.5	1.73

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ALABAMA—Con.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Havana	29, 31	86	2, 3	50	67.6	1.90	......	......	......	......	......	......
Fish River	......	......	......	......	......	......	18, 20, 30	88	16	68	......	......
Averages					68.6	1.78					75.5	8.15
FLORIDA.												
Port Orange	31	92	8	58	73.4	0.81	29, 30	90	5, 10, 11, 15, 23	73	79.6	......
Jacksonville	22	90	4	60	70.3	......	30	97	9	70	80.2	7.66
Pilatka	......	......	......	......	......	......	20	101	13, 14	68	83.8	2.00
Ocala	31	96	4, 5	50	72.0	......	30	98	4	70	......	......
Manatie	30, 31	90	9	62	76.0	1.40	20, 23, 30	96	8, 24	74	83.5	5.50
Chattahoochee	31	93	2	57	72.8	......	21	95	5	67	81.0	4.50
Averages					72.9	1.11					81.6	4.92
TEXAS.												
Gilmer	29	90	13	51	70.9	6.75	28	93	1, 10	66	78.6	1.92
Columbia	29	93	2	53	74.3	3.66	......	......	......	......	......	......
Blue Branch	29	85	2	52	70.6	3.44	30	89	2	67	77.0	3.50
Lavaca	13	88	1	55	74.5	2.00	25, 26, 30	92	1	70	80.0	7.50
Austin	29	88	18	57	72.7	3.85	30	90	10	69	79.0	2.34
Clinton	29	86	1	53	74.2	4.30	25, 26	91	4	68	80.8	2.20
Lockhart	......	......	......	......	......	......	30	94	16, 17	74	82.2	2.50
Averages					72.9	4.00					79.6	3.33
LOUISIANA.												
Shreveport	29, 30	83	1, 2, 3, 19	50	70.0	......	29	92	7, 16	67	79.8	......
MISSISSIPPI.												
Columbus	28	87	2	52	70.0	2.56	29, 30	94	6, 7, 16	63	76.4	3.01
Marion C. H	27, 28, 30, 31	92	2	50	73.1	0.80	28, 29, 30	100	16	58	74.8	1.00
Grenada	29	92	2	46	68.0	3.40	......	......	......	......	......	......
Near Brookhaven	31	89	9	51	69.3	1.50	22	93	17	60	77.1	4.20
Natchez	29, 31	84	2	51	71.2	1.37	30	86	4	63	76.2	5.02
Paulding	27, 31	88	1	49	70.0	2.22	22, 30	92	16	59	78.0	3.48
Averages					70.3	1.98					76.5	3.34
TENNESSEE.												
Elizabethton	29	90	8	38	61.0	6.80	19, 20, 21, 29	90	15	46	71.1	5.90
Tusculum College	29, 31	85	3, 9	46	63.7	0.70	27	87	12	55	73.1	3.90
Lookout Mount'n	......	......	......	......	......	......	30	90	6	59	74.7	......
Clarksville	29	85	1	47	63.0	2.47	19	89	6, 7, 15, 16	55	70.2	4.40
Trenton	30	86	8	45	65.4	3.30	19	96	7	50	74.1	3.80
Memphis	29, 30	91	1	48	66.9	1.74	29	96	6, 7, 15	59	76.2	3.60
Averages					64.0	3.00					73.2	4.32
KENTUCKY.												
Pine Grove	29	88	3	42	61.8	3.46	19	90	6	52	71.1	4.74
Lexington	......	......	......	......	......	......	19	89	6, 7	54	71.1	5.84
Danville	......	......	......	......	......	......	18	90	6	55	73.7	4.69
Louisville	......	......	......	......	......	......	19, 27	91	6	44	71.8	5.18
Clinton	29	87	3	46	63.1	1.93	20	88	6, 15	53	......	2.33
Averages					62.5	2.70					71.9	4.57

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
OHIO.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Steubenville	11, 12	82	3	42	61.0	5.44	20, 27	85	7	48	71.0	4.01
Painesville	12	80	2	35	55.8	4.50	18	82	7	42	62.3	5.63
Gilmore	11	90	2	36	59.5	6.20	26	94	5, 6	50	70.2	5.01
Milnersville	26	84	4	32	55.2	2.96	19, 26	88	5	48	69.1	6.31
Cleveland	11, 12	85	2	37	56.7	3.94	18	85	6	43	64.2	3.52
Wooster	26	85	2	40	60.9	5.98	18, 27	89	7	48	69.7	5.10
Smithville	26	88	2	41	59.9	5.09	27	89	5, 6	47	68.1	4.79
Gallipolis	......	......	......	......	......	......	19	90	8	49	69.4	5.03
Kelley's Island	25, 26	77	2	41	57.1	5.11	29	84	6	50	67.1	6.07
Sandusky	25	82	2	41	57.6	7.99	18, 27	85	7	48	66.4	6.90
North Fairfield	26	82	3	37	57.9	6.04	27	88	5	47	67.0	7.25
Carson	12, 26	80	2	40	57.5	7.83	27	86	6, 8	50	67.7	6.92
Gambier	......	......	......	......	......	......	3, 20, 29	78	5, 6, 7, 8	50	63.0	......
Westerville	29	84	2	42	58.8	5.31	19	88	6	48	68.8	3.98
North Bass Island	......	......	......	......	......	......	27	90	6	49	66.3	4.87
Marion	26	81	2, 3	40	57.0	8.83	27	87	15	44	66.7	4.15
Hillsboro	26, 29	80	3	40	59.4	4.31	26, 27	83	6	47	67.5	4.17
Toledo	25	87	3	38	57.4	5.75	27	88	6	42	66.6	8.25
Bowling Green	25	85	2	40	58.8	9.55	18	93	5	48	69.6	10.07
Kenton	31	82	5	41	63.0	16.75	26	94	7	55	72.6	8.38
Urbana	26	86	2	42	59.1	7.09	19	86	6, 7	50	68.8	2.49
Bethel	29	87	3	39	59.6	4.00	19	90	14	37	70.2	3.50
Jacksonburg	26	84	3	42	60.1	5.34	19	88	7	50	69.1	3.99
Mt. Auburn Sem.	26, 30	82	7	43	62.8	4.42	19	88	5	54	72.6	4.45
Cincinnati... (H)	25, 28, 30	82	2	44	60.6	1.68	......	......	......	......	......	......
Do ...... (P)	29	90	2, 21	48	66.8	5.93	20	92	7	54	73.0	3.60
College Hill	26	88	3	40	61.4	7.32	19	94	7, 8	52	72.8	2.25
Averages	......	......	......	......	59.3	6.14	......	......	......	......	68.5	5.23
MICHIGAN.												
Monroe City	25	86	3	40	57.5	5.61	18	88	6	46	66.0	4.89
Alpena	11	59	2	36	46.0	1.12	28, 30	65	6	41	51.7	5.08
State Agr. College	25	83	18	41	55.5	2.05	2	84	5	44	64.5	4.40
Litchfield	25	82	1	36	55.7	5.00	18	84	5	46	64.4	10.05
Cold Water	10, 25	82	3	30	54.4	5.19	3, 19	86	6	37	63.4	6.63
Old Mission	25	84	2	37	51.8	1.00	2	80	6	37	58.8	5.50
Grand Rapids	25	88	2, 17	41	54.0	......	29	88	6	38	65.0	......
Northport	24	77	3	37	49.5	3.24	2, 3	82	5	36	55.9	7.83
Pleasanton	25	84	5, 16	36	51.3	2.45	3	84	5	38	56.8	8.25
Muskegon	10, 24, 25	80	3, 17	42	58.5	6.50	3, 19	84	5	48	64.6	2.40
Otsego	25	82	19	34	55.4	......	8, 29	84	4	48	64.0	......
Copper Falls	24	73	6	31	46.4	1.10	28	72	5	33	52.3	1.90
Penn Mine	31	74	12, 16, 26	34	48.9	......	......	......	......	......	......	......
Ontonagon	23	76	1, 2, 6, 7, 14, 15, 16, 17, 18, 26	40	50.3	......	2, 3, 7, 8	80	14	44	57.4	......
Averages	......	......	......	......	52.5	3.33	......	......	......	......	60.4	5.65
INDIANA.												
Aurora	26, 29	90	2, 3, 8	42	60.6	4.01	19	95	7	48	71.5	3.70
Vevay	25	84	2	43	61.2	5.95	19	90	7, 8	51	69.9	4.54
Mount Carmel	......	......	......	......	......	......	25	92	5, 6, 15	50	70.8	2.85
Muncie	26	87	1, 2, 19	42	60.4	7.70	19, 25, 26	90	5	47	69.6	4.10
Spiceland	26	85	1, 2	41	58.9	6.03	19	91	5, 6	49	69.9	4.25
Columbia City	25	86	1, 2, 3, 5, 6, 8, 14	40	54.0	6.13	19	94	6, 16	48	71.1	10.38
Jalapa	26	85	1, 2, 7, 18, 19	43	56.8	7.50	26	89	5	44	67.7	3.00
Knightstown	25, 26	84	1	42	59.6	6.98	19	89	5	49	68.9	4.30
Indianapolis	26	83	2	42	59.7	5.49	19, 27	86	5	46	68.5	4.37
Bloomington	25	79	1	43	60.1	5.90	19, 27	86	15	52	69.9	3.15

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY.						JUNE.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
INDIANA—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Near La Porte	......	......	......	......	......	......	27	88	5	48	65.1	10.20
Rensselaer	......	......	......	......	......	......	19	90	5	46	69.2	4.00
Lafayette	26	84	3	36	56.9	7.70	3, 19	86	5	48	60.4	6.60
Merom	26	85	1, 2, 7	43	61.0	4.75	19	91	15	52	71.1	4.75
Kentland	25	86	18	40	58.1	9.25	......	......	......	......	......	......
New Harmony	5	87	1	47	64.4	4.80	19	90	5, 6	56	73.0	5.13
Harveysburg	31	90	16	44	63.9	4.40	19, 25	92	5	50	70.9	6.00
Averages	......	......	......	......	59.7	6.19	......	......	......	......	69.2	5.08
ILLINOIS.												
Chicago	25	81	2	42	54.6	5.69	19	84	6	49	65.8	5.03
Near Chicago	25	84	3	30	51.9	......	19	85	4	45	64.8	......
Evanston	25	82	6	41	51.8	6.59	19	84	4, 5	45	63.0	9.96
Marengo	25	81	7, 8	35	55.3	4.74	3, 19, 29	83	6, 16	46	64.7	7.29
Effingham	26	90	1	41	63.6	5.65	19	94	15	52	73.9	8.36
King's Mills	25	83	7	39	52.9	6.37	19	83	5	46	64.4	7.81
Louisville	26	88	1	44	65.7	5.10	19	90	5	52	72.0	6.40
Golconda	30, 31	89	2	42	64.0	2.20	25	96	5	40	70.2	4.00
Belvidere	25	86	7	42	56.1	4.80	29	81	6	51	64.0	9.68
Sandwich	25	85	2	40	57.1	6.28	8	90	6	48	67.2	7.57
Ottawa	25	83	6, 7	43	50.6	7.45	3	89	6, 15	52	66.5	6.28
Pana	......	......	......	......	......	......	19	89	14, 15	52	70.7	3.10
Winnebago	25	85	6, 7	42	54.8	5.53	29	85	5	45	64.0	4.01
Rochelle	25	84	7	40	56.5	......	29	88	5	50	67.1	......
Wyanet	26	87	7	36	58.4	7.78	19	84	6	44	66.3	9.96
Tiskilwa	25	86	7	40	59.5	......	20, 24, 29	88	5, 6, 7	44	66.9	......
Hennepin	4	82	7	36	59.0	......	......	......	......	......	......	......
Elmira	26	88	7	40	59.7	5.86	19	87	6	50	67.2	12.43
Peoria	26	90	1	41	61.5	6.09	19	90	15	23	69.5	8.35
Springfield	28	88	13	34	61.2	......	19, 28	89	11	46	69.4	......
Loami	26	90	1	41	62.0	6.90	25	88	5	53	71.1	3.65
Dubois	26	86	1	40	65.6	3.06	20	90	7, 15	48	70.3	4.30
Waterloo	26	90	1	44	66.3	4.15	......	......	......	......	......	......
South Pass	25, 26	86	1	43	63.6	......	20	94	5, 15	54	75.2	......
Galesburg	26	85	2, 17	47	60.2	3.18	3, 28	80	5	50	68.7	8.88
Manchester	25, 26	86	1	43	62.9	4.38	25	90	14	48	70.3	4.82
Mount Sterling	25	86	1	43	61.6	......	19, 25	87	5	50	68.4	......
Andalusia	26	85	1	42	59.9	......	19	84	5	50	67.7	......
Augusta	25	85	1	45	64.0	5.18	19	85	6	53	70.4	8.13
Warsaw	9, 10, 26	83	1	46	64.2	8.66	19	89	5	46	69.3	5.90
Averages	......	......	......	......	59.5	8.26	......	......	......	......	68.2	6.95
WISCONSIN.												
Manitowoc	23	78	7	38	51.2	3.40	2	82	5	43	58.1	8.15
Plymouth	25	88	27	40	53.5	5.50	3	85	5	42	60.6	10.90
Hingham	25	85	3	32	52.7	......	29	90	6	35	60.8	......
Milwaukee	25	87	7	36	51.6	4.77	29	85	6	40	59.5	7.67
Appleton	10	75	17	42	54.0	......	......	......	......	......	......	......
Geneva	25	85	2, 3, 5	40	54.9	7.09	29	85	5	44	64.2	4.63
Waupacca	25	85	7, 17, 26, 27	40	55.1	......	3	85	5	45	62.3	......
Embarrass	24	80	7	38	52.8	......	3, 28	80	6	40	59.1	......
Rocky Run	25	86	7	41	56.1	4.53	30	84	6, 14	50	63.3	10.88
Madison	25	82	1	35	54.6	4.90	3	79	5	48	62.6	6.24
Edgerton	25	90	7	36	58.0	4.50	28	87	5	49	64.9	8.80
Baraboo	25	86	12	40	56.4	4.81	3, 29	86	5	42	64.0	14.25
New Lisbon	24	90	15, 17	40	58.2	......	28, 29	87	6	45	63.9	......
Bayfield	23	78	6	28	47.4	......	3	82	5	38	56.2	......
Averages	......	......	......	......	54.0	4.94	......	......	......	......	61.5	8.94
MINNESOTA.												
Beaver Bay	23, 24, 31	72	7	33	46.7	2.63	23	82	5	37	52.6	2.05
Afton	4, 25	88	12	38	56.5	4.25	29	87	5	41	62.7	3.30

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MINNESOTA—Con.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Paul	9	83	12	42	57.7	2.34	3	89	5	47	64.4	2.22
Minneapolis	4	90	2, 12	39	57.6	2.52	30	86	5	47	64.4	3.55
Sibley	4	88	14	39	56.7	1.36	3	86	5	37	63.5	1.81
Koniska	20	93	2	32	55.6	2.15	29	86	5	41	60.4	1.10
New Ulm	4	89	12	42	59.4	1.35	3	87	5	46	65.2	2.52
Madelia	4	90	12	42	60.8	2.25	3	90	5	44	65.9	3.05
Averages	......	......	......	......	56.4	2.36	......	......	......	......	62.4	2.45
IOWA.												
Clinton	25	86	18, 19, 20	44	57.7	3.50	30	88	16	48	66.7	5.80
Davenport	26	82	1	45	58.1	6.18	19	81	6	46	66.6	11.89
Waukon	25	84	12	42	57.1	......	18	86	5	47	63.6	......
Dubuque	10, 25	82	17	42	59.4	4.40	29	87	6	50	68.8	4.68
Monticello	25	83	1	45	58.9	5.55	10	87	5	48	67.2	6.05
Bowen's Prairie	4	86	13	44	54.3	7.30	1, 3	86	14, 15	50	65.7	8.60
Fort Madison	9	88	7, 8	41	61.6	4.73	19	88	15	52	70.8	4.61
Guttenberg	25	88	2, 3, 17	40	57.3	......	3, 11, 30	84	6	41	63.2	......
Mount Vernon	25	85	14	44	58.5	......	28	84	6	43	65.8	......
Iowa City	4, 25	82	7, 18	40	60.0	4.06	3	85	15	47	66.1	7.42
Independence	4	88	16	44	59.8	4.20	28	85	5	47	65.5	8.95
Near Independ'ce	25	88	18	41	56.5	3.70	30	90	5	44	66.7	11.50
Waterloo	4	86	6	43	60.0	4.15	1, 28	86	5	46	65.7	5.15
Vinton	25	85	1, 2, 12	47	61.0	4.40	3, 12	85	4	48	67.0	10.90
Rockford	4, 25	84	14, 17	40	57.8	......	29	87	5, 15	50	66.7	......
Iowa Falls	4	82	13	42	59.6	9.29	3, 28, 30	88	5	48	67.0	4.03
Algona	4	86	12	40	57.6	......	30	82	14	45	66.5	......
West Bend	4	88	12, 13	41	56.6	......	30	85	4	42	63.4	......
Fontanelle	4	91	9, 12, 15	42	60.8	6.63	28, 30	86	14	49	68.6	8.13
Rolfe	4	86	12, 13	40	61.2	4.57	18	93	4	43	67.0	5.35
Granite City	4	93	12, 18	42	61.3	6.12	18, 28, 30	92	4	42	67.3	4.43
Logan	4	92	2	33	58.0	3.50	28	81	5	35	63.4	9.00
Woodbine	4	90	1	40	59.7	......	3	86	4	46	67.8	......
Averages	......	......	......	......	58.8	5.14	......	......	......	......	66.4	7.28
MISSOURI.												
St. Louis Univ	26	89	1	44	65.0	3.34	19	92	5, 15	56	72.1	6.02
Allenton	25	91	1, 19	44	63.1	3.71	19	91	6	48	68.4	8.14
Hematite	5, 26	89	3	43	65.4	3.95	19	91	7	55	73.1	5.45
Rolla	4, 5	86	3	39	61.2	5.66	19	88	15	46	68.0	6.09
Jefferson City	26, 27	86	1, 8	44	65.0	......	19	86	5	50	69.0	......
Keytesville	25, 26	84	1, 12, 13	45	62.2	4.65	23, 30	88	5	51	70.3	7.40
Hermitage	26	88	7, 17	41	61.5	6.42	18	90	5	48	69.0	6.25
Bolivar	5, 26, 27, 29	83	1	46	66.0	4.30	19	86	15	50	72.3	3.80
Warrensburg	4, 5	90	13	45	66.1	4.31	28	90	14	56	73.6	7.67
Harrisonville	5, 25	84	13	42	63.1	3.24	22	88	14	50	69.5	8.29
St. Joseph	4	86	1, 13	46	63.1	5.85	12, 18, 19	84	4, 6, 7, 16	54	71.1	10.65
Oregon	4	88	13	42	61.4	4.42	18, 19, 29	85	15	49	69.4	7.49
Averages	......	......	......	......	63.6	4.53	......	......	......	......	70.5	7.02
KANSAS.												
Atchison	4, 25	88	13, 17	44	62.4	4.60	17, 18	89	4, 5	52	69.9	7.75
Leavenworth	4	86	1	41	62.0	5.30	28	94	4, 14	52	69.9	6.36
Olathe	4	86	13	42	63.6	5.60	3	89	14	51	68.3	9.40
Paola	26	87	13	44	64.5	3.46	20	90	15	44	70.4	6.30
Baxter Spring	25	90	13	46	68.2	6.00	11	92	4	54	75.8	10.20
Lawrence	4	84	13	40	59.9	3.64	23	89	14	48	66.9	7.57
Holton	25	87	8	40	61.2	......	28, 29	92	4	52	67.5	......
Neosho Falls	4	89	13	41	60.4	3.80	28	86	14	48	60.3	8.80
Le Roy	4	93	19	38	64.1	8.11	10	96	5	48	72.0	8.60
State Agr. College	4	88	13	43	58.0	1.12	28	86	14	46	66.4	8.85

Meteorology of 1869—Continued.

Stations in States and Territories.	MAY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	JUNE. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
KANSAS—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Council Grove	4	91	13	47	64.4	3.85	18, 19	86	5, 14	57	71.6	5.95
Crawfordsville	......	......	......	......	......	......	24	87	5	38	68.9	......
Averages	......	......	......	......	62.6	4.55	......	......	......	......	69.0	7.98
NEBRASKA.												
Dakota	4	89	12, 13	46	63.8	......	3	90	14	55	65.7	......
Omaha Mission	4	91	3, 4	40	66.0	2.00	3, 30	89	9	48	67.1	4.75
Elkhorn	4	90	13	43	60.8	......	3, 12, 18, 28	84	5	40	67.1	......
De Soto	4	89	13	41	59.9	3.29	18	86	5	42	65.8	7.13
Fontanelle	4	96	12	43	61.3	......	18	88	14	48	67.6	......
Bellevue	4	91	13	45	62.3	4.50	3, 18	84	4	51	69.6	4.80
Glendale	4	92	2	40	60.6	6.55	17	90	4	48	68.7	9.05
Nebraska City	4, 9, 25	80	13	42	60.8	4.50	18, 19, 24, 28	81	15	52	70.0	8.88
Peru	......	......	......	......	......	......	29	89	14	51	69.5	......
Decatur	4	93	13	42	61.7	3.24	30	90	4	46	67.0	......
Averages	......	......	......	......	61.9	4.01	......	......	......	......	67.8	6.92
UTAH TER.												
Coalville	19	86	26	39	57.6	......	14, 22	88	1	46	65.1	......
CALIFORNIA.												
Monterey	11	80	1	44	58.9	1.09	28	83	1	46	62.8	0.03
Watsonville	10	86	2	50	63.0	0.20	26	80	6	56	64.2	0.00
Vacaville	31	99	22	52	66.3	0.34	28	99	6	56	72.8	0.00
Averages	......	......	......	......	62.7	0.54	......	......	......	......	66.6	0.01
MONTANA TER.												
Fort Benton	31	92	9	42	73.5	5.08	......	......	......	......	......	......
Deer Lodge City	13	82	11	35	58.1	1.00	30	92	3, 7	44	64.6	1.00
Averages	......	......	......	......	65.8	3.04	......	......	......	......	64.6	1.00
WASHINGTON TER.												
Port Angeles	9	63	1, 5, 25	51	54.9	1.39	13	68	5	51	58.0	......

	JULY.					Rain-fall.	AUGUST.					Rain-fall.
MAINE.												
Houlton	3	92	1, 5	52	69.5	2.30	1	86	31	51	62.2	......
Steuben	2	80	19	51	61.6	1.40	11	80	28	49	61.7	2.00
Williamsburg	4, 11	83	1	52	66.1	1.48	11	80	31	46	61.8	2.88
West Waterville	11	87	1, 5	57	69.6	0.93	10	86	31	53	65.7	2.40
Gardiner	11	86	1, 5, 19	59	67.9	1.51	3, 11	79	31	[illegible]	64.4	1.16
Standish	11	88	1	54	70.1	3.54	3, 10	85	31	[illegible]	[illegible]	1.92
Norway	4, 11	88	1	55	68.9	2.10	11	87	[illegible]	[illegible]	64.5	0.57
Cornish	4	90	1	52	68.5	4.03	11	83	31	[illegible]	64.4	2.29
Cornishville	11	88	1, 5	56	71.3	3.27	11	85	[illegible]	[illegible]	[illegible]	2.23
Averages	......	......	......	......	68.2	2.28	......	......	......	......	64.2	1.93
NEW HAMPSHIRE.												
Stratford	28	86	1	48	66.3	2.36	10	84	31	46	61.0	3.17
Whitefield	2	88	1, 5	49	65.6	0.86	10	81	23	44	61.3	2.90

Meteorology of 1869—Continued

Stations in States and Territories.	JULY.						AUGUST.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
N. HAMP—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
North Barnstead	11, 28	88	1	56	70.6	1.11	......	......	......	......	......	2.66
Goffstown Center	11, 25	88	1	49	68.9	1.60	11, 20	86	6, 7	50	65.8	2.88
Averages	......	......	......	......	67.9	1.48	......	......	......	......	62.7	2.90
VERMONT.												
Lunenburg	11	84	1	52	68.2	2.75	25	78	31	48	63.9	2.50
North Craftsbury	3	84	1	47	65.0	3.45	24	82	7	44	60.1	4.42
East Bethel	11	89	1	48	69.0	2.47	10	86	8	46	66.7	1.86
Woodstock	25	83	6	44	65.2	1.76	10, 11	79	7	44	61.6	2.24
Near St. Albans	26	84	1, 5	52	67.9	......	20	84	31	47	64.1	......
West Charlotte	23	91	1	53	71.8	2.75	10	90	8	52	68.3	4.53
Middlebury	4	82	1	54	67.7	2.56	1, 10, 20, 25, 29	75	7, 31	51	64.3	2.85
Panton	25	85	1	55	69.9	3.61	10, 29	82	31	52	66.7	3.50
Averages	......	......	......	......	68.1	2.76	......	......	......	......	64.5	3.13
MASSACHUSETTS.												
Kingston	4	90	2	54	70.2	1.75	11	87	11, 31	52	66.0	1.24
Topsfield	11	89	1	55	69.8	1.31	11	86	31	50	66.3	2.16
Georgetown	27	91	1	54	69.8	1.40	11	91	31	47	66.7	1.95
Milton	16	93	2	56	67.6	2.43	20	90	31	51	68.7	1.95
Cambridge	4	87	1, 2	58	70.6	......	20	88	31	54	58.0	......
North Billerica	16	90	2	58	71.2	......	11, 20	88	7, 8	52	65.7	......
West Newton	11,16,27	96	6	56	74.9	3.77	29	96	30, 31	50	70.6	1.78
New Bedford	16	89	1	57	70.9	1.60	21	81	31	52	65.3	2.70
Worcester	16	87	1	53	70.1	1.40	20	85	31	52	67.2	2.21
Mendon	11, 16	86	1	50	69.6	2.25	20	84	7	54	66.5	2.20
Lunenburg	16	90	1	54	70.2	1.95	29	89	31	50	67.1	3.30
Amherst	16	90	1, 2	54	69.1	2.98	20	87	8	49	66.9	1.04
Richmond	10	84	2	47	68.3	7.25	......	......	......	......	......	......
Williams College	25	86	2	54	68.2	5.17	......	......	......	......	......	......
Hinsdale	8	82	1	50	66.3	2.60	20	86	31	44	65.3	1.85
Averages	......	......	......	......	69.8	2.76	......	......	......	......	66.9	2.03
RHODE ISLAND.												
Newport	4, 16, 17	81	1	58	69.6	0.76	21	82	6, 7, 31	53	67.4	3.21
CONNECTICUT.												
Columbia	16	92	1	56	70.9	......	21	92	7, 8	50	69.3	......
Middletown	16	93	1, 2	55	70.3	3.02	21	89	1, 7, 8	53	68.4	2.81
Waterbury	16	87	2	49	60.1	3.66	21	90	8	48	66.8	......
Colebrook	11, 16	86	1	53	68.3	3.60	20	90	31	47	66.5	1.84
Brookfield	9	98	7	54	71.7	4.50	20, 21	86	8	50	08.1	3.30
Averages	......	......	......	......	71.0	3.70	......	......	......	......	67.8	2.65
NEW YORK.												
Moriches	17	92	1, 6	61	74.4	2.99	21	98	7	55	72.8	2.15
South Hartford	4, 11, 12, 13, 25	84	1	54	72.5	3.12	......	......	......	......	......	......
Hudson	16, 25	90	1, 2	58	71.8	3.67	20	93	8	53	67.9	2.40
Garrison's	11, 16	93	5, 6	58	72.4	1.70	20	95	7	52	72.0	1.33
Throg's Neck	16	95	1	60	72.6	......	21	94	31	56	71.0	......
White Plains	16, 17	87	1, 5, 30	60	70.9	......	20	83	7	53	68.5	......
Deaf & Dumb Inst	16	90	1	61	72.3	4.45	20	93	31	58	73.2	1.85
Columbia College	16	91	14	65	75.0	3.13	21	95	31	56	71.5	1.71
Flat Bush	16	93	6	57	73.9	2.23	20	92	23	55	71.9	2.11
Glasco	16	97	1	54	73.0	1.46	20	100	9	54	72.5	1.54
Newburgh	11	94	1	60	73.8	2.60	20	94	6	56	72.8	1.42

Meteorology of 1869—Continued.

Stations in States and Territories.	JULY. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	AUGUST. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
NEW YORK—Con.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Minaville	16, 25	88	1	52	70.5	5.05	10, 19	96	6	54	69.3	2.15
Gouverneur	26	82	1, 5	53	67.1	3.13	20	81	6	46	63.6	1.74
North Hammond	26	90	1, 5, 6, 11, 12, 22	60	70.4	1.54	23	90	31	50	67.7	1.74
Houseville	25	85	6	49	67.0	7.96	20, 24	84	31	46	64.6	2.86
Leyden	25	80	1	48	63.8	6.04	20	81	31	44	60.1	4.84
South Trenton	25	92	5	50	69.1	10.72	20	88	6, 7, 8, 9	48	64.5	5.22
Cazenovia	25	82	1	51	67.0	......	20	86	31	47	65.4	......
Oneida	25	89	5	52	69.7	12.14	20	90	31	50	68.3	5.95
Depauville	26	84	1	52	66.2	3.65	20	83	31	48	64.7	2.75
Oswego	10, 25	82	1	51	67.0	6.67	20	82	27, 31	52	68.8	4.20
Palermo	25	91	1	40	68.4	4.70	20	93	6, 31	49	65.7	2.60
North Volney	25	89	5	53	69.1	......	20	88	31	52	67.5	......
Ludlowville	15	95	2	53	63.7	......	20	96	8	51	70.3	......
Waterbury	11, 26	90	5	50	68.5	......	20	96	7	42	66.1	......
Nichols	15	96	5	49	69.4	......	20	96	7, 8	48	67.3	......
Newark Valley	16, 25, 26	88	5, 6	55	68.0	4.20	......	......	......	......	......	......
Himrods	15	85	5	54	65.7	4.06	20	90	31	49	66.1	3.31
Rochester	25	84	1, 21	57	68.9	4.90	20	86	31	52	63.4	4.69
Little Genesee	16	85	6	50	67.8	6.13	20	92	8, 31	42	66.2	2.46
Suspension Bridge	15	89	1, 12	51	68.9	......	20	92	7	45	66.2	......
Buffalo	19	87	1, 21	57	70.0	4.57	23	89	5	48	68.7	3.98
Averages	......	......	......	......	69.6	4.61	......	......	......	......	68.0	2.86
NEW JERSEY.												
Paterson	16	95	1	59	73.0	4.95	21	98	6	54	71.8	2.89
Newark	16	92	2	57	72.1	3.69	21	91	9	51	70.3	1.56
Trenton	16	95	6, 22	62	76.4	3.04	21	96	6	56	75.7	0.92
Rio Grande	15, 16	100	1, 5	59	77.0	1.63	21	102	6	50	73.9	0.38
Moorestown	16	94	6	60	73.3	1.98	21	98	31	54	72.2	1.26
Newton	5, 6	92	31	57	70.3	1.92	......	......	......	......	......	......
New Germantown	16	93	2, 6	59	71.7	3.02	21	96	31	54	71.2	1.57
Haddonfield	16	94	6	62	73.6	1.77	20	95	6	56	72.8	0.85
Newfield	16	99	1, 6	61	75.4	......	21	101	8	55	74.4	......
Greenwich	16	93	1, 6, 31	63	75.1	2.82	21	93	6	55	72.9	1.56
Vineland	16	102	6	58	78.3	2.81	21	102	7	54	75.9	1.28
Averages	......	......	......	......	74.2	2.76	......	......	......	......	73.1	1.36
PENNSYLVANIA.												
Nyces	11	92	5, 23	49	67.7	5.20	21	90	7	38	65.6	1.20
Hamlinton	25	88	31	53	67.5	3.25	20, 21	88	31	47	64.7	1.92
Dyberry	11	89	1	50	66.7	2.71	20	90	8	40	63.7	2.26
Fallsington	16	92	6	62	73.0	2.50	21	95	31	56	74.0	1.00
Philadelphia	16	96	1	64	76.3	2.78	21	97	6	58	75.3	1.11
Germantown	16	96	4, 5, 8, 22	62	82.9	......	21	97	7	55	73.7	......
Horsham	16	92	6	60	72.0	2.42	20, 21	94	6	55	71.9	1.30
Plymouth Meet'g	16	92	2	59	73.1	2.33	20	95	6, 7	55	72.2	1.33
White Hall	16	90	7	54	72.7	......	21	94	8	45	71.0	......
Factoryville	11	90	2	50	68.6	2.46	20	93	8	44	66.3	2.10
Reading	16	94	2	57	73.0	2.20	21	96	7, 9	55	73.5	1.02
Parkersville	16	93	24	61	74.9	1.51	21	99	8, 9	55	74.7	0.82
West Chester	16	93	1, 6	60	73.5	1.49	21	94	6	54	72.0	0.77
Ephrata	11, 16	96	1	63	78.4	2.29	20, 21	98	8, 31	60	76.8	1.44
Mount Joy	17	95	1	60	73.9	......	21	105	27	53	74.3	......
Harrisburg	16	94	6	64	76.0	3.77	......	......	......	......	......	......
Carlisle	16	94	2, 6, 23, 24	60	70.2	3.40	20	95	8	52	73.6	1.10
Fountain Dale	16	93	6, 21	60	73.8	3.76	21	94	7	53	71.7	1.89
Tioga	16	85	30, 31	46	67.3	4.55	19, 20	86	6, 8	38	64.3	3.35
Lewisburg	16	92	2, 21	56	70.5	4.11	20	94	7	50	70.2	2.19
Grampian Hills	15	89	6, 21	50	66.8	5.68	20, 25, 28	90	6, 7	46	67.3	2.22
Johnstown	16	99	6	50	69.5	5.59	21	89	7	47	69.4	1.66
Franklin	3, 14, 15	89	4, 5	55	......	......	24, 25	92	31	46	69.6	2.88

Meteorology of 1869—Continued.

Stations in States and Territories.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
PENNSYLVANIA—Continued.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Connellsville	14, 15, 16	90	30	54	72.3	......	20, 21, 22	91	31	48	71.6	......
New Castle	16	89	6	49	72.2	......	20, 21	89	7, 8	45	72.2	......
Beaver	15	88	23	57	71.5	......	20, 25	88	7, 9	53	70.4	......
Canonsburg	15	90	22, 30, 31	55	71.5	4.21	21, 24	93	8	47	71.2	1.43
Averages	......	......	......	......	72.1	3.31	......	......	......	......	70.8	1.65
DELAWARE.												
Milford	15	100	22	62	78.4	1.65	21	103	6, 7, 8, 31	58	70.9	0.30
MARYLAND.												
Woodlawn	16	94	6	58	74.5	5.70	20	94	31	57	72.9	1.13
Annapolis	16	97	23	63	78.4	5.60	21	95	7, 8, 9	59	77.0	1.60
St. Inigoes	16	96	22	66	78.2	2.55	......	......	......	......	......	......
Mt. St. Mary's	16	92	21	58	72.0	2.22	20, 21	94	7	53	72.4	1.22
Averages	......	......	......	......	75.8	4.02	......	......	......	......	74.1	1.32
DIST. COLUMBIA.												
Washington	16	94	23	63	76.8	2.65	22	98	7, 8, 9	59	76.0	0.70
VIRGINIA.												
Johnsontown	11, 16	94	2, 31	64	76.9	3.85	21	95	7	59	75.2	0.20
Hampton	16	99	6	65	80.0	6.30	21, 29	98	6, 9	62	77.5	3.50
Zuni Station	11, 14, 15, 17, 18	98	7	60	80.8	2.37	29	98	7, 9	56	78.7	0.40
Bacon's Castle	11	104	1, 2	66	82.9	......	15, 16, 21	100	31	64	81.0	......
Comorn	11	94	6, 23	63	77.8	2.44	21	95	7, 9	60	77.9	0.61
Vienna	......	......	......	......	......	......	21	96	5, 7, 8	60	76.7	1.40
Staunton	11, 17	93	31	60	75.8	1.70	20	92	8, 9	58	75.0	0.65
Lexington	16	101	31	62	79.0	1.02	20	104	7	56	78.4	1.53
Lynchburg	15, 16, 17	92	6, 7, 31	63	77.6	......	22	95	8	56	77.5	......
Snowville	14, 15	93	23	50	71.9	4.60	21	98	10	46	71.4	0.70
Wytheville	14	92	21, 23	54	72.5	1.38	23	95	9	49	73.1	1.94
Near Wytheville	14, 15	88	23	52	72.0	2.80	21	92	9	47	71.7	2.55
Averages	......	......	......	......	77.0	2.94	......	......	......	......	76.0	1.35
WEST VIRGINIA.												
Romney	15, 16	102	31	60	73.9	......	21	102	7, 31	56	78.9	......
Weston	17	94	23	52	76.6	......	22, 25	91	7	49	71.8	......
Cabell C. H.	11	96	28	40	70.8	3.40	21	96	31	46	77.2	1.30
Averages	......	......	......	......	73.8	3.40	......	......	......	......	76.0	1.30
NORTH CAROLINA.												
Goldsboro	17	107	22, 23	69	84.4	4.42	22	104	8, 9	64	82.2	3.75
Mt. Olive	......	......	......	......	......	......	22	98	9	62	80.5	7.25
Oxford	15	102	6	66	83.0	0.75	22	96	8, 9	56	78.5	2.45
Trinity College	14, 17, 18	98	24	63	81.8	10.45	......	......	......	......	......	......
Chapel Hill	15	103	23	68	82.5	......	21	103	31	69	80.4	......
Albemarle	11, 14, 15	104	23	59	79.1	0.68	21	99	8, 10	50	77.8	5.95
Statesville	15	100	23, 24	60	77.1	1.06	17	98	9, 10	48	76.7	2.56
Asheville (A.)	14	84	23	60	71.7	1.50	22	86	9	51	72.0	0.22
Do. (H.)	15	84	23	54	70.8	......	22	86	9	46	71.4	......
Averages	......	......	......	......	78.8	3.14	......	......	......	......	77.4	3.70

Meteorology of 1869—Continued.

Stations in States and Territories.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
SOUTH CAROLINA.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Aiken........(C).	14	101	7	68	81.4	5.56	15	96	9	61	79.0	5.11
Do........(P).	......	......	......	......	......	......	18	96	8, 9	62	79.8	6.00
Gowdeysville....	11,13,15	99	23	69	82.7	2.05	21, 22	99	1, 11	66	83.4	2.40
Averages....	......	......	......	......	82.1	3.81	......	......	......	......	80.7	4.50
GEORGIA.												
Berne..........	10, 13	93	7	70	79.5	9.17	22	92	8	64	77.5	3.90
Penfield	14	99	23	68	81.0	2.17	22	99	8, 9	62	79.7	1.40
Macon..........	11	103	25	70	78.1	3.34	21	103	8	64	80.8	2.85
Atlanta..........	......	......	......	......	......	......	22	98	9	50	75.7	2.12
Averages....	......	......	......	......	79.5	4.89	......	......	......	......	78.4	2.57
ALABAMA.												
Opelika..........	14	102	25, 27	71	82.8	5.13	22	105	7	65	83.0	2.68
Carlowville......	11	98	7, 19, 20, 22, 25	74	80.2	5.67	14,15,16	98	9	68	82.6	6.63
Moulton	15	90	23	61	76.1	3.76	16	91	9	59	78.9	0.46
Green Springs...	12	97	23	66	81.2	1.38	16, 22	93	10	59	74.1	2.32
Havana..........	11, 14	94	24	60	79.8	1.60	16	98	10	62	80.3	3.20
Fish River.......	10,12,13	89	8	74	......	6.15	......	......	......	......	......	......
Mobile..........	......	......	......	......	......	......	23	95	10	74	83.0	......
Averages....	......	......	......	......	80.0	3.95	......	......	......	......	80.3	3.10
FLORIDA.												
Port Orange	13	92	25	71	81.0	......	30	92	8	74	82.6	......
Jacksonville.....	16, 17, 18, 19, 21	95	25	72	83.3	5.46	22	100	8	73	84.5	5.50
Pilatka..........	4, 13	102	4, 5, 8, 22, 23, 24, 31	72	82.5	8.23	19	101	7, 8, 9, 26, 27, 30, 31	72	82.2	3.60
Ocala	1, 14, 15, 16	98	26,27,31	70	88.8	......	18, 22, 23, 24, 30	98	4, 5, 10	72	83.3	......
Manatee..........	2	94	25, 31	76	84.0	7.80	19, 24	96	2, 28	76	84.0	9.80
Chattahoochee...	5	99	25	68	......	8.80	22	99	10	68	......	......
Averages....	......	......	......	......	83.9	7.57	......	......	......	......	83.3	6.30
TEXAS.												
Gilmer..........	15, 16, 17, 18	95	20	71	82.3	4.32	27	100	10	74	85.1	1.19
Blue Branch	30	93	24	71	80.0	8.80	8	96	19,28,30	75	82.8	1.80
Lavaca	20	95	4	74	82.9	11.30	7	96	3, 4	76	82.0	5.10
Austin..........	30	93	5, 6	71	80.5	9.20	8	97	12, 17, 24, 31	75	83.2	1.14
Clinton	21, 28, 29, 30	94	5	74	82.4	9.35	9, 10, 26	94	17	74	84.1	1.90
Lockart..........	1	94	25	71	81.5	12.00	8	100	3	75	83.4	3.30
Averages....	......	......	......	......	81.6	9.16	......	......	......	......	83.4	2.41
MISSISSIPPI.												
Columbus........	12,13,14	97	23	66	80.7	2.91	16	98	9, 10	67	81.5	3.93
Paulding........	9, 10, 11, 12, 14	95	23	68	81.4	6.20	16, 22	97	9	72	82.5	4.80
Marion	13	102	21, 25	66	80.5	1.30	22, 23	102	1	68	82.7	5.90
Grenada	......	......	......	......	......	......	23	100	9, 10	64	82.0	3.30
Brookhaven......	......	......	......	......	......	......	16	95	8, 10	70	81.3	10.61

Meteorology of 1869—Continued.

Stations in States and Territories.	JULY.						AUGUST.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MISSISSIPPI—Con.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Near Brookhaven	3	94	23	70	82.0	4.90	6, 14	96	9	70	82.0	7.70
Natchez	11, 12, 14, 15	89	23, 25	70	82.8	2.38	23	90	10	71	78.1	4.78
Averages	.....	.....	.....	.....	81.5	3.54	.....	.....	.....	.....	81.4	5.86
ARKANSAS.												
Helena	.....	.....	.....	.....	.....	.....	23,23,24	97	9	70	83.5	.....
TENNESSEE.												
Elizabethton	14,15,16	97	23	53	74.9	3.80	23	100	9	52	76.8	3.89
Tusculum Coll'ge	15	94	23	62	77.9	1.00	23	95	10	60	79.4	1.00
Lookout Mount'n	14, 15	93	23	64	79.0	.....	23	97	7	65	82.5	.....
Austin	12, 13	94	22	56	78.3	1.95	23	102	9	56	81.1	3.47
Clarksville	15	91	22, 23	60	75.2	2.13	23	97	8	60	77.7	1.00
Trenton	5	95	23	59	78.5	7.00	23	101	10	60	81.3	5.70
Memphis	12,14,16	98	31	64	80.2	2.36	16, 23	98	8	65	81.8	3.26
Averages	.....	.....	.....	.....	77.7	3.04	.....	.....	.....	.....	80.1	3.05
KENTUCKY.												
Pine Grove	16	92	6, 31	60	75.4	5.63	22,24,27	96	7, 8	56	76.5	4.29
Lexington	13, 14, 15, 16	90	21, 22	60	75.8	4.55	.....	.....	.....	.....	.....	.....
Near Louisville	15	96	22	53	76.6	3.39	24	99	9	53	78.3	2.73
Averages	.....	.....	.....	.....	75.9	4.52	.....	.....	.....	.....	77.4	3.51
OHIO.												
Steubenville	15, 16	91	6, 30, 31	59	75.4	5.78	21	93	7	52	76.0	1.45
Painesville	3, 10, 15	84	21, 30	55	68.5	6.49	20	87	6, 7	54	69.0	3.50
Gilmore	16	101	21	58	74.3	7.20	20, 21	98	1, 4	54	73.4	1.60
Milnersville	16	93	31	52	72.2	4.33	20, 23	90	7, 9	52	72.2	0.42
Cleveland	10	88	5, 21, 22	53	69.5	3.82	19	91	7	49	70.1	1.12
Wooster	14, 15	94	1, 23, 30, 31	58	74.4	4.60	20	96	31	55	75.3	1.10
Smithville	15	95	29	51	73.0	.....	20	98	31	53	73.9	.....
Gallipolis	15	94	6, 22	54	72.7	4.94	.....	.....	.....	.....	.....	.....
Kelley's Island	10	87	21	60	73.4	1.39	19	90	7, 31	57	74.2	1.50
Sandusky	10, 15	88	21	58	71.9	5.52	20, 25	90	8	53	73.3	1.71
North Fairfield	3, 10, 14, 15	88	21, 22	56	71.6	4.17	19	88	7	54	72.6	3.50
Carson	14, 15	90	1, 5, 21, 31	60	72.7	3.63	.....	.....	.....	.....	.....	.....
Gambier	15	86	21	59	71.8	9.37	.....	.....	.....	.....	.....	.....
Westerville	14, 16	91	5	55	71.9	6.18	20, 25	91	31	50	71.9	2.22
North Bass Island	3	90	5	54	72.6	2.54	19	96	6, 7, 31	57	73.5	1.58
Marion	3, 10, 14, 15	89	21	56	70.7	7.53	21	91	18	40	71.8	3.08
Hillsboro	16	88	21, 29	57	74.0	3.34	19	91	7	53	74.1	0.82
Toledo	14	94	30	52	72.5	2.63	19, 20	95	7	50	73.1	0.63
Bowling Green	14	96	21	58	74.1	6.41	15, 19	98	6, 7, 31	54	75.5	0.93
Kenton	16	97	23	65	77.7	8.50	25	100	31	60	79.8	1.13
Urbana	14	93	30, 31	56	72.8	6.53	25	92	7	55	73.9	1.01
Bethel	16	94	31	56	75.6	1.38	19, 24	95	31	54	79.5	0.50
Edgerton	10	91	21	52	73.5	4.97	.....	.....	.....	.....	.....	.....
Jacksonburg	15, 16	92	21	56	74.2	2.85	24	96	9	56	77.4	2.52
Mount Auburn	17	96	5	64	80.0	4.52	26	99	7	59	80.3	1.46
Cincinnati ... (H)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do. ...... (P)	14, 16	95	22	64	80.9	5.36	21	95	9	63	81.8	1.20
College Hill	11, 12, 13, 14, 15, 16	93	5, 30, 31	60	79.3	3.44	20, 21, 22, 24	96	6, 9, 31	60	78.3	4.06
Averages	.....	.....	.....	.....	73.7	4.90	.....	.....	.....	.....	74.8	1.69

Meteorology of 1869—Continued.

Stations in States and Territories.	July: Date.	July: Maximum temperature.	July: Date.	July: Minimum temperature.	July: Mean temperature.	July: Rain-fall.	August: Date.	August: Maximum temperature.	August: Date.	August: Minimum temperature.	August: Mean temperature.	August: Rain-fall.
MICHIGAN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Monroe City	10	90	21	59	73.1	5.30	20	90	30	42	70.1	1.75
Alpena	10	71	1, 14	53	......	5.84	19, 24	72	5	54	62.6	2.46
State Agr. College	10	91	22	54	70.4	5.77	19, 21	92	31	46	70.6	4.85
Litchfield	10	88	30	55	69.4	6.26	19	88	31	51	70.1	4.55
Cold Water	14, 25	86	30	50	68.8	3.69	24	90	7	44	69.7	3.75
Old Mission	2	88	11, 20	52	68.4	2.50	24	92	7	50	67.[illegible]	1.40
Grand Rapids	10	90	20	54	72.1	......	24	94	6, 30	54	71.9	......
Northport	10	83	5	48	65.4	3.13	24	92	6, 7, 31	50	64.8	3.38
Pleasanton	2	85	22	50	65.4	4.20	19, 24	90	7	46	64.3	3.55
Muskegon	9	90	22	58	73.4	2.50	24	94	7, 30, 31	54	73.3	2.30
Otsego	10	90	18, 29	54	69.8	......	10	98	6, 8	54	67.4	......
Copper Falls	1	79	4	38	60.6	1.47	19	80	7	37	65.4	1.78
Ontonagon	9, 15	86	10	52	66.6	......	24	80	31	50	62.6	......
Averages	......	......	......	......	68.6	4.07	......	......	......	......	67.7	2.98
INDIANA.												
Aurora	13, 14, 15, 16	98	31	56	76.3	2.42	19, 23, 24, 25	100	8	54	78.9	0.60
Vevay	16	93	30	59	75.8	0.90	23	95	8, 9	57	76.6	2.10
Mount Carmel	15	95	21	61	76.7	0.60	13, 23, 25	96	9	60	78.7	2.32
Muncie	15	92	30, 31	57	72.8	11.15	14	98	7	56	75.2	3.20
Spiceland	16	93	21	59	69.0	5.74	24	93	7, 31	57	74.9	4.50
Laconia	15, 16	95	22, 30	62	77.2	2.32	23, 24	99	7	59	75.7	4.23
Columbia City	14	92	22	57	71.7	8.81	19, 24, 25	90	8	56	73.1	2.31
Knightstown	16	92	5	59	73.0	6.99	25	94	7, 8	58	74.5	4.17
Indianapolis	16	91	30	56	73.7	3.44	19, 20, 24	96	31	55	74.2	1.39
Bloomington	15, 16	89	30	60	74.0	5.12	23, 24	90	7	58	75.5	3.05
Near La Porte	3, 14	89	29	58	73.0	12.10	20, 24, 27	91	7, 31	57	73.6	3.85
Rensselaer	14, 15	90	4, 20	60	73.8	10.60	24	93	31	55	74.6	3.15
La Fayette	3, 10, 14, 16	88	30	52	72.2	8.00	23, 27	90	7	50	74.7	5.90
Meron	13	94	5	60	75.7	3.20	24	96	7	58	77.2	1.90
Kentland	10	88	5	56	71.1	20.50	23	95	7	52	73.5	4.75
New Harmony	16	93	30	63	77.9	2.59	24	95	8	60	80.1	4.67
Harveysburg	15	94	21, 29, 31	60	76.6	4.55	23	96	31	58	77.6	2.70
Averages	......	......	......	......	74.1	6.41	......	......	......	......	75.8	3.22
ILLINOIS.												
Chicago	3	90	20, 21	60	73.4	3.26	24	95	8	62	73.1	1.32
Near Chicago	10	92	20, 29	57	72.9	......	20	96	16	61	74.3	......
Evanston	3, 10	87	20	58	70.4	3.15	19	89	5, 6	61	70.7	3.94
Marengo	3	86	21	50	68.4	2.28	24	91	30	51	69.4	4.60
Mattoon	......	......	......	......	......	......	3, 22, 23	94	31	61	78.2	......
Effingham	12	98	5	62	78.1	4.50	3	98	30, 31	62	80.2	2.75
King's Mills	10	86	4	57	70.6	2.88	24, 27	89	7	51	70.2	3.82
Louisville	16	95	5	60	77.7	6.10	23	100	7, 31	60	77.0	2.70
Golconda	2, 17	98	21	44	77.6	2.09	26	105	1	72	85.9	1.00
Belvidere	10, 24	85	21, 30	56	68.2	5.39	19	92	7	53	69.8	4.69
Sandwich	24	90	4, 20, 30	58	70.6	3.25	23, 24	93	7, 31	53	71.4	7.57
Ottawa	10	92	29	58	71.8	4.44	24	98	31	54	75.3	4.24
Pana	16	95	5	61	76.5	3.50	24	94	8	60	77.9	6.05
Winnebago	10	87	4, 21	56	67.5	2.91	24	91	7, 30, 31	52	70.5	4.22
Rochelle	10	90	20	58	71.2	......	27	96	7	50	74.0	......
Wyanet	3	89	21	53	71.1	6.86	24	93	8	50	72.8	3.37
Tiskilwa	10	92	29	54	71.1	......	13, 23, 27	94	7	52	75.8	......
Hennepin	24	88	5, 21	......	71.0	......	27	95	31	50	74.0	......
Elmira	10	90	30	58	71.3	3.73	24	92	7, 31	57	73.5	7.01
Peoria	10	92	21	57	73.4	7.35	24	95	7, 30	61	76.4	3.39
Springfield	15, 16	92	4	56	76.6	......	25	98	31	61	78.1	......
Loami	16	92	5	61	75.9	6.50	25	96	7	58	77.8	0.50
Dubois	13	93	21, 29	58	80.8	4.42	22	98	7	62	80.7	3.57
South Pass	1, 16	94	21	62	78.0	......	18	100	8, 31	62	80.5	......
Galesburg	10	87	5, 20, 29	60	72.0	9.00	24	95	31	55	70.6	6.85
Manchester	13, 16	96	20	56	75.8	6.99	27	97	7, 8	58	78.7	1.86

Meteorology of 1869—Continued.

Stations in States and Territories.	July. Date.	July. Maximum temperature.	July. Date.	July. Minimum temperature.	July. Mean temperature.	July. Rain-fall.	August. Date.	August. Maximum temperature.	August. Date.	August. Minimum temperature.	August. Mean temperature.	August. Rain-fall.
ILLINOIS—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Mount Sterling	10, 16	90	21	61	73. 4	......	24	96	8, 31	57	76. 8	......
Andalusia	3	88	5, 21, 22	58	72. 1	......	24	89	7	55	74. 0	......
Augusta	10	87	5, 21	63	74. 4	7. 77	24	92	31	55	76. 3	6. 60
Warsaw	10	90	5, 20, 21	62	74. 6	8. 42	24	95	31	60	77. 6	6. 71
Averages	......	......	......	......	69. 4	4. 99	......	......	......	......	75. 4	4. 14
WISCONSIN.												
Manitowoc	24	89	11, 21	56	66. 9	3. 54	19	92	31	50	66. 0	4. 77
Plymouth	10	88	20	52	69. 0	2. 39	19, 24	92	6, 31	47	67. 0	3. 70
Hingham	24	94	12, 20	55	69. 7	......	24	92	7	44	67. 3	......
Milwaukee	24	90	1, 21	51	68. 8	2. 76	24	93	7	48	67. 0	3. 70
Geneva	10	89	5, 12, 30	59	71. 0	3. 53	23	91	8	52	70. 1	4. 38
Waupacca	24	91	21	55	69. 3	......	19, 24	92	31	50	64. 5	......
Embarrass	10, 24	88	29	50	64. 2	3. 73	19	90	31	48	65. 5	6. 03
Rocky Run	10, 24	86	29	56	69. 1	2. 94	24	90	30, 31	52	73. 5	5. 06
Madison	10, 24	84	20	58	69. 1	3. 63	24	89	5	54	66. 9	5. 92
Edgerton	7	88	29	54	69. 3	......	19, 23, 24	92	8	55	70. 5	5. 90
Baraboo	10	90	29	52	68. 9	2. 50	24	94	7	48	69. 3	4. 13
New Lisbon	24	95	30	52	72. 2	......	19, 24	94	30, 31	50	68. 8	......
Bayfield	1, 9, 25	86	28	50	65. 9	......	......	......	......	......	......	......
Averages	......	......	......	......	68. 7	3. 12	......	......	......	......	68. 0	4. 84
MINNESOTA.												
Beaver Bay	25	85	13, 14	45	58. 8	4. 09	3	89	30	45	58. 3	6. 08
Afton	2, 24	91	29	52	68. 7	1. 60	3, 18	87	31	52	67. 7	7. 30
St. Paul	24	90	4	56	69. 7	1. 67	12	84	17, 30	56	68. 4	7. 62
Minneapolis	2	92	19	52	68. 5	2. 95	3, 11	85	30	52	68. 1	11. 64
Sibley	24	91	29	47	66. 3	3. 19	4	87	30, 31	51	68. 8	5. 42
Koniska	21	90	4	50	66. 7	1. 40	4	81	17, 28, 29, 31	50	64. 9	5. 75
New Ulm	24	92	4	55	71. 3	2. 90	23	90	16	59	72. 4	5. 30
Madelia	24	91	28	56	72. 6	3. 25	4, 18	94	16, 28	58	75. 1	7. 04
Averages	......	......	......	......	67. 8	2. 63	......	......	......	......	68. 0	7. 02
IOWA.												
Clinton	10	88	21, 29	55	70. 7	6. 50	24	95	8	54	72. 6	8. 45
Davenport	10, 24	84	21	59	70. 4	11. 46	24, 27	89	31	55	72. 4	4. 18
Waukon	9, 24	87	4, 20	56	68. 6	......	4, 23	91	6	52	69. 1	......
Dubuque	24	91	29	58	72. 1	3. 54	24	95	6	53	72. 3	7. 76
Monticello	10	88	30	50	71. 8	8. 31	19	90	7, 31	54	71. 6	6. 41
Bowen's Prairie	24	88	5	54	68. 2	5. 60	23	91	7	50	68. 7	5. 55
Fort Madison	9, 10	90	29	60	74. 3	7. 05	20, 23	93	31	52	76. 0	5. 91
Guttenberg	10, 24	90	21, 29, 31	50	68. 1	......	4, 24	92	8	48	69. 2	......
Mount Vernon	23, 24	88	4, 29	60	71. 6	......	27	92	31	51	71. 8	......
Iowa City	10	86	21, 29	52	70. 9	7. 42	24	93	8, 17	57	74. 3	11. 43
Independence	24	91	4, 29	58	71. 1	7. 95	19, 23, 24	92	31	55	72. 6	8. 15
Near Independ'ce.	14	95	21, 28	55	72. 3	9. 40	27	97	7	53	72. 8	6. 80
Waterloo	10	87	6	54	71. 0	7. 40	4	94	28	50	71. 0	7. 10
Vinton	24	92	20	60	72. 0	4. 70	4, 13, 24	93	6, 31	59	72. 3	7. 40
Rockford	2	86	4	54	71. 1	......	4	88	8	52	69. 3	......
Newton	......	......	......	......	......	......	23, 24, 27	92	7	54	72. 4	8. 95
Iowa Falls	24	92	4, 30	58	71. 2	7. 70	4, 25	90	31	62	76. 2	6. 50
Algona	24	84	29	56	68. 1	......	4, 22, 23	88	31	52	69. 0	......
West Bend	2	89	4	54	69. 5	......	4	89	6, 17, 31	54	68. 7	......
Fort Dodge	......	......	......	......	......	......	......	......	......	......	......	......
Mineral Ridge	24	87	5, 28	58	72. 1	11. 30	17, 23	99	29	54	72. 7	7. 90
Fontanelle	2, 23, 24	89	28	57	73. 7	14. 50	5	97	30	56	74. 8	14. 00
Rolfe	2, 8, 24	90	29	55	72. 5	4. 85	4	93	30	56	72. 8	4. 97
Grant City	23	95	28	56	73. 8	6. 00	3	98	30	56	75. 1	8. 52
Logan	10	87	29	51	68. 8	8. 90	5, 26	88	5	51	71. 0	7. 90
Woodbine	2	91	4, 5, 25, 28	54	70. 1	......	4	94	30	54	73. 6	......
West Union	10, 29	89	5, 12, 13, 29	58	73. 3	......	4	94	6, 7, 8, 30, 31	58	73. 3	......
Averages	......	......	......	......	71. 1	7. 80	......	......	......	......	72. 1	7. 66

Meteorology of 1869—Continued.

Stations in States and Territories.	JULY. Date.	JULY. Maximum temperature.	JULY. Date.	JULY. Minimum temperature.	JULY. Mean temperature.	JULY. Rain-fall.	AUGUST. Date.	AUGUST. Maximum temperature.	AUGUST. Date.	AUGUST. Minimum temperature.	AUGUST. Mean temperature.	AUGUST. Rain-fall.
MISSOURI.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Louis Univ'ty	17	93	5, 21	62	77.5	2.26	23	95	31	61	79.6	4.79
Allenton	13,15,16	95	30	54	74.6	1.82	23	101	8	55	77.1	2.75
Hematite	16	94	22	61	77.8	4.55	23	96	9	63	79.7	7.10
Rolla	14, 16	90	21	61	74.8	4.60	27	93	7	62	78.0	1.97
Jefferson City	14	92	21	60	76.0	......	24	96	31	60	76.0	......
Keytesville	9	94	20, 21	62	75.4	7.55	26	99	8, 31	61	78.1	4.50
Hermitage	6	92	20	58	74.0	5.25	27	96	8	59	77.3	1.04
Bolivar	16	93	21	65	78.6	3.10	23	95	8	66	81.8	2.81
Warrensburg	3, 16	92	5	62	80.8	3.01	26	100	7	62	80.4	4.35
Harrisonville	16	92	20	62	75.4	2.03	6, 24, 25, 26, 27	94	8, 29	62	77.1	3.85
St. Joseph	10, 13, 23	89	20	65	79.7	8.40	27	95	31	63	79.3	5.41
Oregon	2, 9	91	30	58	74.8	5.74	27	97	30	61	77.7	6.90
Averages					76.6	4.34					78.5	4.13
KANSAS.												
Atchison	1, 13	91	30	61	76.1	8.85	6, 26, 27	96	7, 30, 31	65	80.1	4.25
Leavenworth	16	100	20	55	75.5	9.00	6	103	30	63	78.9	3.41
Olathe	13	98	20	59	76.7	17.70	25	97	29	61	78.1	4.90
Paola	3, 9, 13, 15, 16	90	20	62	75.9	8.86	26, 27	96	29	63	78.2	7.90
Baxter Spring	17, 26	92	18, 29	72	81.4	4.60	24, 26	98	30	74	84.8	1.85
Lawrence	16	90	29, 30	55	72.2	5.05	6	94	30	58	75.3	6.46
Holton	13	96	20	63	78.3	......	2, 6	98	31	62	80.7	......
LeRoy	16	109	30	60	77.5	2.40	25	104	29	66	82.2	2.95
State Ag. College	13	93	25	56	73.5	6.27	27	91	30	62	76.0	2.43
Council Grove	9, 13, 16, 24, 27	90	30	62	77.8	4.50	6	95	29	62	80.0	9.60
Crawfordsville	12, 14	90	21	55	74.3	1.55	6	96	8	64	78.8	2.70
Averages					75.5	6.88					79.4	4.65
NEBRASKA.												
Dakota	23, 24	94	5, 28	60	73.3	......	4	99	29	54	74.8	......
Omaha Mission	2	93	28	60	72.0	4.27	4	98	30	60	75.9	4.06
Elkhorn	2	90	28	57	72.0	......	5	93	17, 20	59	73.7	......
De Soto	2, 23	91	28	56	71.3	8.60	5	95	20	56	73.6	6.25
Fontanelle	2	92	4, 28	60	62.2	9.40	5	97	7	61	......	......
Bellevue	2	89	29	60	74.1	5.60	5	92	30	57	75.9	11.20
Glendale	2	92	25, 28, 29	56	73.3	7.59	5	94	29	53	75.2	8.00
Decatur	13	92	28	56	72.0	4.28						
Averages					71.3	6.60					74.9	7.38
UTAH TERRITORY.												
Great Salt Lake City	22	93	18	62	73.0	......	2, 14	88	13, 17, 25, 26	65	76.7	......
Coalville	25, 27	91	11	60	72.1	......	17	91	10	54	70.5	......
Averages					72.6	......					73.6	......
CALIFORNIA.												
Monterey	13	80	9	50	65.7	0.01	5	80	24	45	61.8	0.00
Watsonville	12	84	8	58	70.0	......	4, 25, 28	83	23	50	65.7	......
Vacaville	19, 25	98	8	59	75.8	0.05	9	98	12	56	73.4	0.00
Stoney Point	14	97	6, 7	55	69.4	0.20						
Averages					70.2	0.09					67.0	0.00
MONTANA TER.												
Deer Lodge City	20, 29	92	6, 7	45	66.5	0.25	6	95	16, 19, 28	40	63.1	0.50
WASHINGTON TER.												
Port Angeles	31	69	7	55	60.2	......	2	70	23	54	59.3	4.17

Meteorology of 1869—Continued.

Stations in States and Territories.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MAINE.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Houlton	5	84	28	36	62.7	2.10	2	73	31	15	45.5	10.90
Steuben	5	77	28	37	56.4	2.00	1	71	28	20	45.5	6.31
Williamsburg							1	72	28	22	42.0	15.10
West Waterville	5	86	28	40	62.4	5.09	1	77	28	23	47.5	13.87
Gardiner	7	78	28	41	60.8	3.37	1	72	28	25	47.1	12.67
Lisbon							1	83	28	17	46.4	9.90
Norway	6	86	28	34	60.4	4.40	1	77	28	19	44.7	15.10
Cornish	5	81	28	40	60.4	3.38	1	75	28	19	45.2	13.29
Cornishville	5, 6	82	28	40	63.0	4.17	1	74	28	24	47.4	11.89
Averages					60.9	3.50					45.7	12.11
NEW HAMPSHIRE.												
Stratford	15	83	28	33	59.9	3.39	2	75	28, 31	20	41.2	8.49
Whitefield	5, 6	82	28	32	59.2	3.55	2	77	31	17	41.4	9.14
North Barnstead						4.42	1	83	28	25	48.1	13.17
Tamworth							1	79	28	19	44.8	13.84
Concord							1, 2	75	28	24	47.5	
Goffstown Center	5	87	29	43	62.9	3.76	7	72	28	26	47.9	15.71
Averages					60.7	3.78					45.2	12.07
VERMONT.												
Lunenburg	8	84	28	36	62.1	2.60	1	72	28	21	42.9	5.08
North Craftsbury	8	80	28	32	59.0	4.06	2	70	31	14	39.4	10.72
East Bethel	7	85	28	35	61.7	2.35	1	77	28	21	43.3	10.45
Woodstock	5	80	28	34	59.1	3.44	1	71	31	20	41.9	12.90
Hartford	20	82	27	38	66.3	2.90						
Near St. Albans	8	84	28	38	62.4		2	73	31	22	43.4	
West Charlotte	8	87	27, 28	43	67.0	3.84	1	77	28, 31	26	46.5	11.38
Middlebury	8	79	28	37	62.6	3.08	1	68	28	27	45.7	9.28
Panton	7	84	28	40	64.3	3.88	1	74	28	24	45.1	14.05
Castleton							2	73	28	23	44.4	12.47
Averages					62.7	3.27					43.6	10.79
MASSACHUSETTS.												
Kingston	20	86	28	36	63.0	3.09	3	80	28	25	52.2	6.20
Topsfield	20	85	28	37	63.3	3.54	2	76	28	19	46.9	5.22
Newbury	5, 8	82	28	36	61.5		2	73	28	20	46.9	
Lawrence							1, 2	74	28	23	47.0	8.21
Milton	20	91	28	40	60.5	3.78	1	83	28	24	51.9	4.59
Cambridge	20	86	28	42	63.1		2	71	31	27	49.2	
North Billerica	20	86	28	36	63.9		1	77	28	22	49.0	
West Newton	20	91	29	38	64.8	8.83	1	82	28	28	50.2	6.28
New Bedford	20	85	28	41	61.3	2.53	1	73	28	23	49.5	6.73
Worcester	20	83	28	39	62.5	4.74	1	74	28	25	47.9	9.81
Mendon	20	84	28	35	62.3	6.60	2	78	26, 28	26	47.3	7.50
Lunenburg	20	87	28	38	62.6	3.00	1	77	28	23	47.2	12.50
Amherst	20	85	28	36	62.1	4.32	1, 2	71	25, 26, 28	27	46.7	11.36
Williams College	7, 20	82	28	38	61.6	3.18	2	72	28	23	40.7	10.68
Hinsdale	20	80	27, 28	36	60.3	4.30	1	76	26	21	43.0	12.15
Averages					62.3	4.35					47.7	8.44
RHODE ISLAND.												
Newport	20	82	28	46	63.6	3.19	2	71	28	31	52.1	5.38
CONNECTICUT.												
Columbia	20	90	28	38	63.4		1	82	26	24	49.6	
Middletown	20	88	28	37	63.4	3.66	1	81	26	23	47.4	14.51
Colebrook	20	82	28	36	61.2	5.25	1	76	26	21	44.4	12.46
Brookfield	20	86	29	40	64.0	3.70	1	77	26	27	50.6	9.90
Averages					63.0	4.20					48.0	12.29

Meteorology of 1869—Continued.

Stations in States and Territories.	September. Date.	September. Maximum temperature.	September. Date.	September. Minimum temperature.	September. Mean temperature.	September. Rain-fall.	October. Date.	October. Maximum temperature.	October. Date.	October. Minimum temperature.	October. Mean temperature.	October. Rain-fall.
NEW YORK.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Moriches	20	96	28, 29	45	67.3	5.69	2	79	21, 26	30	53.4	12.86
South Hartford	7	88	28	39	67.2	3.10	1	78	28	27	48.0	13.85
Fort Edward	......	......	......	......	......	......	2	78	28	26	47.9	......
Hudson	7, 20	87	29	42	66.2	3.68	1	79	27	29	48.6	14.40
Garrison's	20	88	28	44	65.2	4.26	1	74	26	25	48.6	10.49
Throg's Neck	20	86	28	44	65.9	......	1	72	22, 23	31	50.1	......
White Plains	20	82	28, 29	44	63.2	......	1, 2	72	26	26	49.8	......
Deaf and Dumb Institution	20	86	27	48	67.6	4.07	2	75	31	33	52.0	6.78
Columbia College	20	86	27, 28	51	68.4	2.72	1	72	27, 31	32	50.7	6.30
Flatbush	20	85	28	45	65.5	3.46	1	72	30	35	53.2	6.77
Glasco	16	88	27, 28	43	65.2	3.07	1, 2	72	26	24	46.8	9.15
Newburgh	20	87	28	44	65.3	4.30	......	......	......	......	......	11.91
Minaville	20	85	28	40	63.9	4.70	2	76	27	25	45.9	7.20
Cooperstown	......	......	......	......	......	......	2	75	27	22	43.4	6.10
Gouverneur	7	79	28	35	61.1	4.05	2	72	27	18	44.7	5.67
North Hammond	14, 15	88	28	38	64.6	5.30	2	78	27	25	48.0	7.24
Houseville	20	83	28	34	62.0	6.12	1, 2	74	27	15	41.7	6.97
Leyden	20	79	28	34	59.5	6.25	2	70	27	16	39.9	7.60
South Trenton	6	86	27	40	62.1	5.28	2	71	31	27	43.2	5.63
Cazenovia	20	81	27	40	61.6	......	2	73	26, 27, 31	25	42.8	......
Oneida	13	88	28	42	62.0	5.14	2	78	27	27	45.7	8.93
Depauville	5	82	27	34	62.8	6.95	9	77	27	23	43.6	7.10
Oswego	7	81	27	44	63.1	3.65	2	75	31	30	48.6	5.10
Palermo	20	85	28	40	61.7	3.89	1, 2	75	27	23	43.1	5.10
North Volney	19, 20	85	27	41	68.5	......	2	79	27	27	46.0	......
Perry City	20	91	28	41	65.0	......	......	......	......	......	......	......
Waterbury	19	89	28	36	61.0	......	1	74	21, 31	18	41.5	......
Nichols	5, 20	86	27	38	62.5	......	1	77	31	22	42.9	......
Newark Valley	20	86	27, 29	38	61.4	3.90	1	76	21	20	45.6	4.10
Himrods	20	83	28	40	62.1	3.06	2	73	26, 30	28	46.6	3.19
Rochester	19	80	27, 28	44	63.4	5.11	2	73	26, 27, 30	30	45.5	2.83
Little Genesee	19	85	29	34	60.4	4.75	1	76	27	18	40.0	2.06
Suspens'n Bridge	20	88	28	39	63.2	......	9	78	27	25	46.2	......
Buffalo	24	87	27	39	65.8	7.43	9	80	27	23	45.1	3.30
Averages	......	......	......	......	63.8	4.58	......	......	......	......	46.2	7.23
NEW JERSEY.												
Paterson	20	88	28, 29	42	64.8	2.98	2	75	26	26	48.1	8.04
Newark	20	86	28, 29	43	64.2	2.54	1	72	26	29	49.6	6.82
Trenton	7, 20	85	28	46	68.5	1.98	1, 2	73	26	32	52.6	6.62
Rio Grande	20	90	28	40	67.6	3.75	2	82	25	26	50.7	6.75
Moorestown	20	87	28, 29	47	65.6	3.23	2	75	26	26	48.7	5.66
New Germanto'n	20	88	28	39	64.9	3.82	1	76	26	22	47.6	8.62
Readington	13	92	29	38	64.7	......	1	84	26	24	49.1	......
Haddonfield	20	85	27, 28	46	65.7	2.70	2	77	26	27	49.1	6.63
Newfield	7	90	58, 30	42	66.3	......	2	81	26	22	49.0	......
Greenwich	21	84	29	45	66.1	3.10	2	74	26	29	50.6	5.43
Vineland	6	86	28	42	67.3	6.63	2	81	26, 31	27	50.2	6.75
Averages	......	......	......	......	66.0	3.41	......	......	......	......	49.6	6.81
PENNSYLVANIA.												
Nyces	6	85	28	30	61.0	4.30	1	71	31	18	41.0	9.70
Hamlinton	5	88	27, 28	40	62.5	5.85	1	78	26	24	46.8	8.06
Dyberry	5	84	28, 29	32	58.8	4.33	1	75	26	17	41.8	6.40
Fallsington	20	85	28	46	66.3	3.60	2	75	26	30	49.7	6.10
Philadelphia	20	86	28	49	68.6	3.27	2	75	31	33	51.6	6.07
Germantown	6	86	28	41	67.1	......	7, 9	79	26	26	50.2	......
Horsham	10	88	28	44	65.4	4.80	1, 2	74	26	27	50.0	6.49
Plym'th Meeting	20	84	29	41	65.3	3.82	2	76	26	27	48.6	7.70
White Hall	7	83	29	38	64.4	......	1	80	26	23	48.5	......
Factoryville	20	83	28	33	61.3	3.65	1, 2	74	26	18	42.8	6.97
Reading	7	85	29	43	66.0	4.83	1	71	26	29	49.5	9.49
Parkersville	20, 21	87	29	43	67.2	5.19	2	73	26	29	45.1	5.78

Meteorology of 1869—Continued.

Stations in States and Territories.	September. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	October. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
PA.—Continued.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
West Chester	......	......	......	......	......	......	2	74	26	27	47.3	6.99
Ephrata	8, 21	90	29	45	70.9	4.83	1, 2	70	27	30	50.1	8.97
Mount Joy	21	87	29	42	66.8	......	12	90	27	28	49.3	......
Carlisle	7, 20	90	29	40	66.1	1.90	1	78	26	26	48.0	6.30
Fountain Dale	21	85	28	43	63.8	2.84	1	69	25, 26	25	45.7	6.47
Tioga	7, 15, 17, 19, 20, 22, 23, 24	84	28, 29	38	62.0	6.00	1	74	26	18	42.4	2.65
Lewisburg	7, 20, 21	85	27	38	63.3	2.92	1	68	26	20	44.1	5.20
Grampian Hills	20	85	29	33	59.3	3.96	1	72	26	12	39.2	1.81
Johnstown	19	86	29	36	60.9	3.03	1	72	26	16	44.0	2.28
Franklin	20	86	29	40	62.0	10.19	1, 9	75	27	17	43.8	1.97
Connellsville	25	87	28	36	63.0	......	9	74	25	20	43.3	......
New Castle	19	81	28	35	62.0	......	2	70	26	23	44.8	......
Beaver	6, 19, 20, 24	80	27, 29	43	63.2	10.80	2	72	26, 27	26	46.5	0.40
Canonsburg	19, 24	88	28, 29	35	63.0	5.69	1	81	26	18	43.6	2.00
Averages	......	......	......	......	64.0	4.79	......	......	......	......	46.1	5.61
DELAWARE.												
Milford	5, 21	89	27	42	68.0	3.20	2	82	26, 27, 31	28	46.5	3.65
MARYLAND.												
Woodlawn	21	88	29	44	66.4	3.04	2	74	26	28	48.5	4.79
Annapolis	21	87	28	42	69.3	4.04	2	77	25	31	52.9	7.19
St. Inigoes	......	......	......	......	......	......	2	78	31	31	54.0	3.50
Mt. St. Mary's	21	85	29	44	61.5	2.59	1, 5	69	25	27	47.1	6.94
Averages	......	......	......	......	65.7	3.22	......	......	......	......	50.6	5.61
DIST. COLUMBIA.												
Washington	21	86	28, 29	49	68.2	2.40	2	69	26, 31	32	50.6	7.33
VIRGINIA.												
Johnstown	21	90	29	50	69.6	2.20	2	82	27	36	54.8	3.45
Hampton	21	92	29	46	70.5	1.10	2	78	27, 31	34	55.2	3.80
Zuni Station	23	90	29	44	69.2	3.68	1	80	27, 31	33	54.6	4.97
Bacon's Castle	8	92	29	48	71.6	......	2	82	27	32	55.6	......
Comorn	21	86	28	53	70.2	3.29	2	77	27, 31	33	52.6	6.98
Vienna	8	86	29	42	68.8	3.71	3	77	31	34	52.2	5.30
Staunton	22	82	28	44	64.1	3.84	1	69	27, 31	30	48.1	3.14
Lexington	22	90	29	41	67.4	4.73	1	78	26	31	52.3	3.88
Lynchburg	21, 22	82	29	45	66.5	......	2	69	27	33	53.7	......
Snowville	22, 23	86	29	30	60.6	3.70	2	76	27	22	46.1	3.60
Near Wytheville	22	82	29	36	61.5	4.20	1, 9	68	27	25	47.1	2.70
Averages	......	......	......	......	67.3	3.38	......	......	......	......	52.0	4.20
WEST VIRGINIA.												
Romney	20	94	29	40	68.3	......	......	......	......	......	......	......
Cabell C. H	23	84	8	45	63.8	1.80	1, 6	72	24	24	48.2	1.10
Averages	......	......	......	......	66.1	1.80	......	......	......	......	48.2	1.10
NORTH CAROLINA.												
Kenansville	18, 22	89	3, 28	50	71.4	......	2	84	28	34	60.3	......
Goldsboro	22, 24	93	28	50	73.5	1.35	2	88	31	32	59.3	3.35
Mt. Olive	23	88	28	53	69.5	5.10	2	82	31	29	56.5	2.50
Oxford	21	86	28	......	......	......	......	......	......	......	......	......
Chapel Hill	19	89	27	55	74.7	......	1	85	31	48	67.9	......
Albemarle	22	92	29	36	66.5	2.50	2	78	28	22	51.8	2.75

Meteorology of 1869—Continued.

Stations in States and Territories.	SEPTEMBER.						OCTOBER.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
N. CAR'A—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Statesville	22	86	28, 29	38	65.6	6.75	3	73	28	22	48.8	1.75
Asheville ....(A)	2, 19, 21, 22, 23	76	28, 29	36	62.5	1.50	3	70	27, 28	24	49.0	1.80
Do ......(H)	21, 22	76	28, 29	34	61.7	......	2, 3	68	27, 28, 31	24	48.5	......
Averages	......	......	......	......	68.2	3.44	......	......	......	......	55.3	2.43
SOUTH CAROLINA.												
Aiken ......(C)	22, 23	87	28	51	71.2	1.79	4, 12	76	27, 31	36	59.9	1.37
Do......(P)	20, 22	88	28	54	71.0	3.00	......	......	......	......	......	......
Fort Mill	22	90	30	50	71.2		......	......	......	......	......	......
Gowdeysville	22	90	29	51	73.3	1.77	3	78	31	30	59.2	2.37
Averages	......	......	......	......	71.7	2.52	......	......	......	......	59.6	1.87
GEORGIA.												
Berne	7, 8	84	28	58	72.1	4.50	3	80	30, 31	36	61.2	......
Penfield	17, 22	88	28	49	71.5	1.60	3	77	31	30	57.8	1.22
Atlanta	17, 20, 22	86	28	44	66.8	2.30	21	75	27	27	53.1	1.87
Averages	......	......	......	......	71.0	2.80	......	......	......	......	57.4	1.55
ALABAMA.												
Opelika	17	94	27, 28	57	76.1	0.44	3	84	31	35	61.3	0.56
Carlowville	13, 23	88	28	52	73.2	1.95	2	82	31	32	60.2	2.40
Moulton	1, 5, 19, 23	80	28	45	66.8	6.60	2	72	31	31	48.9	3.91
Greene Springs	17, 20	86	28	49	71.1	1.67	1	81	27	32	56.8	2.50
Havana	22	86	28	50	71.9	4.20	1, 2	80	27	33	57.5	2.90
Fish River	1, 4, 18	86	28	60	......	......	2	84	......	......	......	......
Mobile	18, 21, 22, 23	88	28	55	76.8	......	2	86	28	36	62.3	2.40
Averages	......	......	......	......	72.7	2.97	......	......	......	......	57.7	2.45
FLORIDA.												
Port Orange	7, 8	90	29, 30	72	79.0	......	12	85	31	49	70.9	......
Jacksonville	26	91	27	68	78.5	7.00	22	87	31	44	68.1	4.15
Pilatka	14, 15, 16	92	27, 28, 29, 30	64	75.7	6.13	5, 12, 22	84	28	48	68.8	4.34
Ocala	8, 9, 14	96	2, 4, 23, 30	70	80.3	......	11, 21, 28	92	17, 18	40	69.7	......
Manatee	8, 10, 11, 14, 15, 20, 25, 27	90	30	74	81.2	2.40	1, 2, 3, 4, 5, 9, 10, 11, 12, 19	88	31	56	76.2	0.50
Chattahoochee	16, 20, 23	91	9	58	......	4.50	20	85	31	40	66.7	0.90
Averages	......	......	......	......	78.9	5.01	......	......	......	......	70.1	2.47
TEXAS.												
Gilmer	2, 4	90	29	47	73.1	5.70	14	86	31	31	59.1	2.18
Palestine	......	......	......	......	......	......	1	86	24	42	64.5	2.00
Blue Branch	6	91	13	48	71.8	0.70	27	88	16	40	63.2	1.30
Lavaca	1, 2, 3, 5	90	27	58	77.3	8.80	1, 10	85	23, 24	46	66.0	5.90
Austin	2	95	29	54	74.9	4.16	14	86	24	40	62.1	2.72
Clinton	1, 2	94	27	56	77.3	7.85	4, 21	86	24	44	65.6	1.75
Averages	......	......	......	......	74.9	5.44	......	......	......	......	63.4	2.64
MISSISSIPPI.												
Columbus	17, 18	88	27, 28	49	71.7	5.15	1	81	28	30	55.3	2.11
Paulding	18	92	28	50	73.3	3.80	19	87	31	37	57.8	......

Meteorology of 1869—Continued.

Stations in States and Territories.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MISS.—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Marion C. H	6, 11, 18, 19	92	10	56	75.4	6.00	8	88	28	32	61.1	3.60
Grenada							1	84	27, 31	28	57.3	3.75
Brookhaven	27	90	29, 30	50	72.7	4.76						
Near Brookhaven	18, 22, 23, 25	86	29	50	73.3	5.00	1	83	28	36	60.6	7.30
Natchez	21	84	29	50	71.2	2.48	1	81	31	34	58.3	4.62
Averages					72.9	4.20					58.4	4.28
ARKANSAS.												
Helena	18	90	27	48	72.2		11	81	24	30	52.7	
TENNESSEE.												
Elizabethton	22	88	28	34	66.5	2.25	8	78	27, 28	22	50.5	3.70
Tusculum College	18, 21	86	28	43	67.6	0.70	1	75	27	27	52.9	2.70
Lookout Mount'n	19	87	27, 28	49	71.2		2	77	27	27	53.8	
Austin	23	88	28	42	68.9	4.75	8	76	26	24	50.1	4.60
Clarksville	18	86	28	42	66.1	2.55	1	78	27	24	48.2	2.74
Trenton	21	90	28	41	69.2	1.30	1	81	27	24	52.4	2.60
Memphis	18	89	28	44	68.6	1.30	1	83	27	24	50.4	3.99
Averages					68.3	2.14					51.2	3.39
KENTUCKY.												
Pine Grove	22, 23	88	28	40	66.0	3.62	2, 8	76	27	17	46.8	1.65
Danville	22	93	28	42	70.1	3.82	1	82	27	23	50.5	1.82
Shelby City							1	75	27	19	46.6	
Louisville	19, 20, 21	85	27	49	66.9	2.40	1	74	27	27	49.2	1.79
Near Louisville	23	91	27, 28	38	68.9	3.29	1	79	27	18	47.1	3.16
Averages					68.7	3.28					48.0	2.11
OHIO.												
Steubenville	21	86	28	43	68.1	7.49	2	73	26	25	48.0	0.59
Painesville	19	81	28	44	59.4	8.00	2	71	25, 26	28	44.6	6.09
Gilmore	5	90	2	47	65.8		2	80	24, 25	26	45.1	2.90
Milnersville	18	85	28	32		8.10	1, 2	74	25, 26, 27	18	41.9	0.60
Cleveland	6	87	28	43	63.9	6.27	8	74	25	24	44.9	2.66
Wooster	19	92	28	36	56.1	5.40	8	80	25	22	46.3	1.80
Smithville	24	89	28	37	64.8							
Gallipolis	5	88	28	38	66.0	4.45						
Kelley's Island	24	85	27	48	67.5	1.99	1	74	25	29	47.0	1.93
Sandusky	24	86	28	41	64.2	3.46	8	74	25	24	44.9	2.96
North Fairfield	19, 20	86	28	38	64.5	3.82	1	78	25, 27	24	45.0	1.57
Gambier							2	68	25	21	42.9	2.49
Westerville	21	86	28	39	62.6	3.57	1	74	27	21	44.3	2.23
North Bass Island	4, 19	86	27	46	67.2	1.75						
Marion	19, 24	84	28	36	62.5	3.93	1, 8	71	27	19	42.3	2.31
Hillsboro	19, 20, 21, 24	81	28	41	64.1	3.63	1, 8	69	27	20	43.4	1.58
Toledo	20	89	28	37	64.8	1.63	1	77	25	21	44.3	2.81
Bowling Green	19, 20, 24	90	28	32	65.2	3.68	8	78	25	16	44.2	3.95
Kenton	19	94	28	45	67.9	3.10	1	74	27	22	50.4	3.10
Urbana Univer'ty	19	88	28	38	65.2	3.32	1	76	27	20	43.7	1.89
Bethel	19	91	27	44	65.5	3.75	8	75	25, 27	20	44.7	2.00
Edgerton	18	87	28	31	62.9	2.02						
Jacksonburg	24	88	27	42	67.2	3.27	1	76	27	20	45.6	2.34
Mt. Auburn Sem.	5, 19	89	30	48	76.6	2.59	15	89	24	26	54.7	2.90
Cincinnati .. (H)	23, 24	90	28	43	67.4	2.81	1, 8	78	25	21	45.4	1.60
Do. .... (P)	25	88	28	46	69.3	3.20	1, 2, 8	72	27	26	48.3	2.75
College Hill	19	89	29	45	68.0	2.50	2	76	27	20	45.8	2.63
Averages					65.5	3.91					45.6	2.43

Meteorology of 1869—Continued.

Stations in States and Territories.	SEPTEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	OCTOBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MICHIGAN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Monroe City	20	86	27	32	58.6	2.67	1	66	27	21	41.9	0.90
Alpena	19	70	27	42	60.1	1.54	1	64	25	28	43.6	1.36
State Agr. College	19	89	27	38	63.5	1.43	7	74	27	18	40.8	1.72
Litchfield	19	86	28	39	62.2	2.03	1	72	25, 27	20	39.3	2.78
Coldwater	18, 20	85	27, 28	36	61.6	2.19	8	72	27	18	41.0	2.69
Old Mission	19	86	22, 26	40	64.2	3.60	......	......	......	......	......	......
Grand Rapids	19	90	27	37	61.6	......	1	77	24, 25, 26, 27, 30	26	42.7	......
Northport	19	82	27	37	61.2	7.60	1	76	24	24	42.7	5.08
Pleasonton	19	84	27	34	59.4	4.15	1, 8	72	31	20	39.7	5.25
Muskegon	19	88	9	46	68.0	1.40	1	78	......	......	......	......
Otsego	18	98	26, 27	37	64.4	......	7	72	31	30	44.9	......
Copper Falls	19	78	27	33	56.3	1.42	8	70	25	19	35.3	2.61
Ontonagon	19	84	27	42	60.3	......	8	70	22, 24, 25, 26	26	41.8	......
Averages	......	......	......	......	61.9	2.74	......	......	......	......	41.2	2.80
INDIANA.												
Aurora	20	94	28	36	67.0	2.59	1	78	27	20	45.5	2.38
Vevay	18, 23, 24	88	28	42	66.6	3.05	1	77	27	21	46.5	2.97
Mount Carmel	19, 24	88	27	45	67.2	4.15	1	74	27	16	44.4	2.80
Muncie	24	88	28	37	64.8	1.95	1	75	25	15	43.2	1.50
Spiceland	19	90	27	39	64.4	1.87	1	76	27	15	42.9	......
Laconia	18, 20, 23	88	28	42	67.0	2.54	1	76	27	18	46.0	2.32
Columbia City	19	87	28	35	64.4	1.81	1	72	25, 27	18	45.1	1.30
Knightstown	19	86	28	37	65.2	1.75	1	76	25, 27	16	42.9	1.79
Indianapolis	4	89	28	36	60.6	2.17	8	74	26	20	41.0	1.60
Bloomington	19	84	28	41	63.0	1.56	1	73	25, 27	18	43.5	1.41
Near La Porte	19, 24	86	28	40	65.0	1.95	1, 8	74	25	17	44.0	1.70
Rensselaer	19	90	28	37	63.9	2.05	1	75	25	15	44.0	0.95
Merom	20	86	27, 28	42	63.4	2.35	1	76	25	17	44.1	1.55
Kentland	19	86	27	42	62.7	4.00	8	79	28	15	44.5	2.30
New Harmony	18, 19, 20, 23	86	27, 28	45	67.5	2.43	1	78	27	29	46.8	1.28
Harveysburg	24	91	28	32	66.2	0.50	7, 8	74	24	10	43.6	2.10
Averages	......	......	......	......	64.9	2.30	......	......	......	......	44.3	1.88
ILLINOIS.												
Chicago	19	90	28	42	67.3	0.89	1, 8	78	25, 27	25	45.8	1.10
Near Chicago	19	88	28	40	63.7	......	1, 8	76	25	16	43.0	......
Evanston	24	83	28	43	64.1	0.64	1	76	25	19	42.6	0.72
Marengo	19	86	26	34	60.3	0.98	1	76	25	13	38.5	0.97
Mattoon	18, 19	86	26, 27	42	66.8	......	8	76	24, 25	20	45.5	......
Louisville	20, 24	89	28	34	65.5	4.30	1	80	24, 25	15	43.9	2.60
Golconda	9	97	3	42	65.0	0.80	5	79	27	10	52.5	0.60
Belvidere	19	86	23	34	61.4	2.59	7	76	25	13	39.8	0.88
Sandwich	18	88	28	34	61.2	1.33	8	74	25	12	40.8	0.70
Ottawa	......	......	......	......	......	......	1	83	23	23	49.7	1.18
Decatur	......	......	......	......	......	......	7, 8	80	24	16	44.2	1.91
Pana	19, 23	86	28	42	65.6	2.15	8	75	24, 27	18	44.7	1.35
Winnebago	19	84	26	37	61.2	3.85	8	74	25	15	38.4	0.83
Rochelle	19, 24	85	26	36	61.3	......	7, 8	75	25	13	40.2	......
Wyanet	19	86	26	36	63.7	0.67	8	78	24, 25	17	42.8	0.81
Tiskilwa	19, 24	82	26, 28	34	62.0	......	1	76	24	17	41.9	......
Hennepin	......	......	......	......	......	......	1	78	24, 25	18	45.0	......
Elmira	......	......	......	......	......	......	8	78	24	13	40.8	0.35
Peoria	19	88	26	41	66.7	0.74	8	77	24, 25	18	45.2	1.52
Springfield	19	90	28	42	66.4	......	5, 7	78	25	20	45.5	......
Loami	18, 24	88	28	40	66.8	1.90	......	......	......	......	......	......
Dubois	24	91	28, 29	42	65.8	2.75	8	73	25	13	46.1	1.35
South Pass	18, 20, 23	88	27	43	68.5	......	1	73	25	27	46.5	1.87
Galesburg	19	86	26	39	61.5	1.06	8	80	25	16	39.4	1.50
Manchester	23	90	26, 27	36	66.2	1.94	7	79	25	11	44.0	1.67

Meteorology of 1869—Continued.

Stations in States and Territories.	September.						October.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
ILLINOIS—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Mt. Sterling	19	86	26	40	64. 4	1. 30	3, 7	72	26	18	45. 7	1. 30
Andalusia	19	82	26, 27	40	64. 0	......	8	75	25	20	43. 8	......
Augusta	18, 19	83	26	40	64. 6	1. 82	8	78	26	16	44. 0	2. 21
Warsaw	19	88	27	40	65. 1	5. 90	7	80	26	22	46. 1	1. 92
Averages					64. 4	1. 98					43. 8	1. 30
WISCONSIN.												
Manitowoc	5	78	27	37	59. 0	1. 84	1	62	24	20	40. 8	0. 69
Plymouth	19	85	26	32	60. 0	3. 60	7	67	24	16	38. 4	1. 20
Hingham	18	84	27, 28	33	61. 1	......	1	70	25	16	40. 2	......
Milwaukee	18	83	27	38	60. 3	1. 97	8	75	24, 25	20	41. 4	0. 46
Appleton	19	78	27	37	60. 8	......	8	69	24	20	43. 0	......
Geneva	18, 24	85	27, 28	36	61. 5	0. 93	8	78	25	12	40. 8	0. 65
Waupacca	19	84	26	36	61. 6	......	8	73	26	18	41. 5	......
Embarrass	19	84	26, 27	33	59. 7	3. 88	8	71	24	14	38. 8	0. 87
Rocky Run	......	......	......	......	......	......	8	73	25	12	40. 3	0. 38
Madison	19	81	26	40	61. 8	2. 68	8	71	25	17	37. 7	0. 66
Edgerton	19	90	27	34	62. 6	3. 10	7	78	25	18	42. 3	1. 10
Baraboo	3	82	27	31	61. 6	2. 25	7	74	23, 24, 25	18	39. 4	7. 00
New Lisbon	19	86	26	32	61. 5	......	9	80	26	14	42. 5	......
Averages					61. 0	2. 53					40. 6	1. 45
MINNESOTA.												
Beaver Bay	9	80	26	33	54. 9	10. 70	5, 6	62	23	15	36. 9	1. 11
Afton	18	84	25	32	60. 7	7. 35	7	73	23	15	34. 9	0. 92
St. Paul	18	87	27	32	61. 3	10. 61	6, 7	71	23	17	39. 6	0. 88
Minneapolis	18	86	27	28	58. 9	11. 45	7	73	23	12	37. 3	0. 65
Sibley	18	86	27	29	59. 9	6. 60	6, 7	72	23	11	39. 5	0. 03
Koniska	18	84	26	30	55. 4	10. 00	6	64	24	9	36. 7	0. 50
New Ulm	18	87	25, 26	40	61. 7	5. 70	6, 7	70	23	16	39. 7	0. 61
Madelia	18	88	25, 26	40	63. 6	6. 60	6	78	23	13	40. 4	0. 64
White Earth	18	78	25	28	55. 1	18. 51	5, 6	72	22	10	33. 9	6. 65
Averages					59. 1	9. 72					37. 7	1. 32
IOWA.												
Clinton	19	88	26, 27	38	62. 8	4. 00	7	80	27	12	41. 6	1. 50
Waukon	18	84	25, 27	36	50. 1	......	7	75	26	10	37. 7	......
Dubuque	18	83	26	39	62. 5	3. 47	7, 8	74	26	20	42. 3	1. 50
Monticello	18	85	26, 27	40	62. 6	2. 75	7	76	26	16	40. 2	1. 35
Bowen's Prairie	18, 23	84	27	36	58. 4	2. 95	7	74	24	14	40. 4	2. 30
Fort Madison	19	85	26	36	63. 8	2. 76	8	76	26	16	42. 5	2. 00
Guttenberg	18	87	26	32	59. 2	......	7	81	25	8	38. 3	......
Mt. Vernon	18, 19	83	27	33	60. 6	......	7	72	24, 26	16	40. 5	......
Iowa City	10	88	27	33	63. 2	3. 09	7	78	26	16	42. 7	2. 07
Independence	18	87	27	37	60. 5	......	7	77	26	12	39. 9	1. 50
Near Independ'ce.	18	89	25	39	62. 3	......	......	......	......	......	......	......
Waterloo	18	88	27	30	63. 1	4. 95	7	80	26	14	39. 8	......
Vinton	19	87	27	34	62. 0	3. 03	7	77	26	18	41. 6	1. 05
Rockford	18	81	27	34	60. 9	......	7	71	23	18	41. 8	......
Newton	18	86	27	32	61. 0	6. 10	7	80	26	12	41. 2	1. 50
Iowa Falls	12	84	27	34	61. 2	9. 76	6, 7	72	25, 27	20	42. 4	0. 51
Ames	23	82	27	36	62. 9	5. 60	......	......	......	......	......	......
Algona	18	86	27	33	60. 5	......	7	75	26	10	40. 2	......
West Bend	18	84	27	31	59. 3	......	7	76	26	12	37. 8	......
Boonesboro	18, 23	85	27	28	65. 8	5. 36	7	75	23	13	40. 3	......
Mineral Ridge	19	89	27	32	67. 3	14. 40	7	81	26	13	41. 8	2. 30
Fontanelle	18	85	27	33	61. 2	6. 00	7	79	26	13	40. 9	0. 63
Rolfe	18	86	27	32	61. 1	......	7	79	26	12	40. 1	0. 80
Grant City	18	89	27	31	62. 4	6. 80	7	84	26	8	41. 1	0. 30
Logan	18	83	27	32	60. 2	7. 10	7	74	23, 24	12	40. 5	0. 80
West Union	18	88	26	37	63. 3	......	7	79	24, 26	13	41. 2	......
Averages					61. 5	5. 51					40. 7	1. 31

Meteorology of 1869—Continued.

Stations in States and Territories.	September. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.	October. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain-fall.
MISSOURI.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Louis	19	86	26	45	67.3	1.74	8	77	26	26	50.0	1.75
Allentown	18, 24	91	28	36	65.7	1.60	7	86	25	14	45.6	2.74
Hematite	18, 24	88	28	33	66.2	2.40	8	79	25	14	48.0	2.45
Rolla	19	86	27, 28	39	64.9	2.31	8	78	26	18	44.8	2.53
Jefferson City	......	......	......	......	......	......	6, 7	72	25	19	46.0	......
Keytesville	24	85	27	30	65.4	4.50	3, 7	76	26	17	44.0	2.90
Hermitage	12, 24	88	27	36	64.3	1.72	7	79	26	12	43.6	2.32
Bolivar	5, 11, 17	84	27	44	68.8	1.20	3	76	25	24	54.9	1.21
Harrisonville	18	84	27	42	65.3	3.55	7, 13	76	26	20	46.1	0.16
St. Joseph	......	......	......	......	......	......	7	79	23, 26	23	50.8	0.20
Oregon	10, 11	89	27	37	65.0	3.28	7	85	26	16	45.8	1.24
Averages	......	......	......	......	65.9	2.48	......	......	......	......	47.2	1.75
KANSAS.												
Atchison	4, 18	86	27	39	64.7	3.40	7	82	26	12	45.7	2.00
Leavenworth	3, 17; 18, 23	86	27	40	64.1	4.50	7	80	26	12	48.8	1.26
Olathe	1	88	27	32	65.0	5.30	7	80	26	12	45.2	2.70
Paola	17	88	27	34	66.0	4.00	7, 13	82	26	15	46.9	1.80
Baxter Spring	1	88	25, 27	52	72.2	3.70	7	80	23, 25	24	51.2	2.41
Lawrence	17	83	27	35	59.9	4.45	7	77	23	16	43.8	0.69
Holton	3	89	25	44	65.5	......	7	82	26	11	45.3	......
Neosho Falls	......	......	......	......	......	......	13	78	26	12	41.7	1.20
Leroy	1	99	26	38	68.0	5.29	7	84	24, 26	18	50.3	1.55
State Agr. College	2, 3, 17	83	27	41	61.9	1.83	7	79	23	14	44.8	0.43
Council Grove	3, 17, 18	86	8	45	67.0	5.70	7	84	26	24	48.4	1.20
Crawfordsville	......	......	......	......	......	......	13	78	23, 26	20	46.7	0.85
Averages	......	......	......	......	65.4	6.23	......	......	......	......	46.2	1.46
NEBRASKA.												
Omaha Mission	17, 18, 23	85	25, 26	40	60.6	7.83	1, 3, 5, 6	76	23	20	47.1	1.10
Elkhorn	18	84	27	38	61.5	......	7	78	24, 26	16	43.0	......
De Soto	10, 18	83	27	37	60.4	9.74	7	78	23	10	42.7	0.80
Fontanelle	23	85	25, 27	40	63.1	......	6	79	23, 24	16	......	......
Bellevue	3, 18	84	27	37	63.5	4.60	7	80	24	19	45.3	0.40
Glendale	18, 23	85	26	33	62.0	5.20	7	82	23	10	42.1	0.75
Nebraska City	......	......	......	......	......	6.05	7	79	23	19	45.6	0.53
Averages	......	......	......	......	61.9	6.68	......	......	......	......	44.3	0.72
UTAH TERRITORY.												
Coalville	1, 17	84	30	42	61.5	......	12	84	25	18	46.0	......
CALIFORNIA.												
Monterey	27	94	19	44	62.9	0.02	3	90	28	42	59.5	1.36
Watsonville	26	99	20	43	65.4	0.20	2	95	13, 14	40	53.6	2.05
Vacaville	26	96	22	58	72.0	......	10	90	30	53	66.4	2.57
Stoney Point	25	101	23	44	72.1	0.40	......	......	......	......	......	......
Averages	......	......	......	......	67.9	0.21	......	......	......	......	59.8	1.99
MONTANA TER.												
Deer Lodge City	8	85	25, 26	26	51.4	0.10	4	79	19	0	35.7	0.00
WASHINGTON TER.												
Port Angeles	3, 6	61	10	50	55.9	3.30	4	59	22, 23	48	54.1	1.50

Meteorology of 1869—Continued.

Stations in States and Territories.	November. Date.	November. Maximum temperature.	November. Date.	November. Minimum temperature.	November. Mean temperature.	November. Rain and melted snow.	December. Date.	December. Maximum temperature.	December. Date.	December. Minimum temperature.	December. Mean temperature.	December. Rain and melted snow.
MAINE.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Houlton	21	56	26, 29	11	31.2	1.32	27	44	6, 9	—15	20.6	5.10
Steuben	4, 6	56	19, 26	17	33.6	5.50	1	52	4	— 1	27.9	8.38
Williamsburg	4	50	26	12	28.8	3.50	1	40	15	— 7	20.9	6.05
West Waterville	4	58	26	19	34.0	3.41	17	45	9	— 4	25.4	5.18
Gardiner	4	56	26	20	34.6	3.10	1	49	10	— 7	25.3	4.74
Lisbon	4	70	11, 26	15	33.4	4.91	11	53	10	—11	25.9	4.10
Norway	4	61	26	16	31.9	4.45	1	45	10	—10	23.7	4.25
Cornish	4	63	26	16	32.0	4.20	1	48	9	0	25.7	2.93
Cornishville	4	63	16	18	33.2	4.20	1	50	4	5	27.3	6.21
Averages					37.6	3.84					24.7	5.22
NEW HAMPSHIRE.												
Stratford	4	60	26	8	28.6	2.93	27	44	10	- 5	21.3	4.58
Whitefield	4	59	26	11	29.2	1.04	1	44	8	—24	21.9	2.63
Shelburne	......	......	26	9	......	......	11	41	10	—14	......	......
Tamworth	4	69	25, 26	9	31.3	4.15	1	48	9	—20	23.0	5.63
Concord	4	68	26	15	34.0	......	1	50	8	—15	26.5	......
Goffstown Center	5	63	16	18	35.1	2.84	17	44	8	6	28.1	2.76
Averages					31.6	2.74					24.2	3.90
VERMONT.												
Lunenburg	5	56	26	13	30.5	2.00	1	40	8	—12	22.0	3.03
North Craftsbury	4	64	26	6	27.6	1.53	26	40	8	— 5	20.2	4.19
East Bethel	4	59	25, 26	9	30.3	2.04	1	47	8	—13	24.8	2.69
Woodstock	4	57	26	7	30.0	2.29	1	43	8	—18	22.4	2.94
Near St. Albans	4	60	24	8	29.9	......	22	44	8	— 8	22.4	......
West Charlotte	5	60	25	19	34.7	1.53	26	44	8	0	26.1	4.05
Middlebury	4	56	25, 26	18	35.0	1.30	1	45	8	— 1	27.5	3.45
Panton	4	58	25, 26	18	33.9	1.49	1	42	8	0	29.1	4.67
Castleton	4	58	26	15	32.7	1.20	1	45	8	— 9	25.9	6.92
Newport	......	......	......	......	......	......	28	40	8	— 8	25.5	4.00
Averages					31.6	1.67					24.6	3.99
MASSACHUSETTS.												
Kingston	5	66	16	22	40.3	1.55	28	53	8	4	32.5	3.25
Topsfield	4	64	16	16	36.2	1.73	1	49	10	— 3	28.0	6.66
Newbury	4	66	16	16	36.5	......	17	50	10	0	29.0	......
Lawrence	4	64	16	14	34.8	2.34	1	51	10	— 6	28.2	4.21
Georgetown	4	63	16	17	36.0	2.85	26	50	10	2	29.7	5.10
Milton	4	72	16	18	41.1	2.02	17	62	4, 10	3	34.4	4.98
Cambridge	4	76	16	21	40.1	......	1	53	10	4	31.5	......
North Billerica	5	70	16	16	36.9	......	12, 27	48	10	— 9	28.8	......
West Newton	4	70	26	19	37.8	......	22	54	8	— 4	30.6	......
Worcester	4	69	16	18	33.0	2.43	1	46	4, 10	7	29.7	5.25
Mendon	4	66	16	13	35.4	2.51	22	50	10	0	28.1	2.60
Lunenburg	4	65	16	15	35.6	1.35	22, 27	47	8	5	29.1	5.15
Amherst	4	57	26	17	35.9	2.59	22, 30	43	9	— 8	27.5	4.96
Richmond	4	62	27	14	31.5	4.30	27	47	9	6	26.5	4.10
Williams College	4	60	26	13	34.1	......	22, 26	45	8	— 2	27.2	4.40
Hinsdale	4	60	25, 26	10	30.7	2.45	27	50	7	1	25.1	2.87
Averages					36.0	2.37					29.1	4.46
CONNECTICUT.												
Columbia	4	76	25, 26	22	38.2	2.43	22	52	9	4	31.9	5.76
Middletown	4	63	26	18	36.9	3.06	1, 22	50	10	— 5	29.2	5.80
Colebrook	4	67	26	12	33.2	4.03	27	48	10	3	26.7	4.15
Brookfield	20	66	26	25	39.6	5.60	27	52	8	0	32.5	7.30
Averages					37.0	3.78					30.1	5.75

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
NEW YORK.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Moriches	2	64	19	25	42.0	4.91	11	57	10	7	37.1	5.39
South Hartford	4	64	26	14	35.6	2.50	17	46	8	— 4	27.9	4.10
Fort Edward	4	60	26	17	36.8	0.65	17	51	10	4	32.1	......
Hudson	4	65	1	24	38.5	2.72	1	50	10, 15	12	31.5	5.11
Garrison's	4	57	26	22	36.1	4.27	22	53	10	10	32.8	4.43
Throg's Neck	4	60	25, 26	24	40.5	......	......	......	......	......	......	......
White Plains	4	64	25, 26	23	39.7	......	12	48	10	12	32.6	......
Deaf & Dumb Ins	17	59	25	27	40.7	3.25	22	55	7	16	34.6	5.79
Columbia College	4	60	25, 26	26	37.3	3.28	28	53	7	14	36.0	6.50
Rutger's Fem. Col.	4	62	25	26	40.6	3.45	22	60	7	16	36.3	4.15
Flatbush	4	58	25	26	41.5	3.00	4	50	7	15	32.2	3.74
Glasco	4	50	26	18	35.8	4.10	......	......	......	......	......	......
Newburgh	4	62	26	26	39.6	2.10	22	49	8	12	32.0	3.30
Minaville	4	58	25	7	33.6	2.75	21	40	7	6	26.2	3.70
Cooperstown	5	59	25	6	33.1	1.91	22	49	7	— 2	27.0	3.69
Gouverneur	......	......	25	— 3	29.9	3.85	22	44	7	— 4	26.6	2.68
North Hammond	4	65	25	4	32.9	3.77	11	48	7	— 4	23.5	4.60
Houseville	4	64	25	9	30.6	4.92	27	49	7	— 2	25.8	3.68
Leyden	4	59	24	13	28.5	4.90	26	42	7	— 4	23.8	7.70
South Trenton	3	64	25	6	32.0	6.61	10	41	7	2	27.3	4.10
Cazenovia	4	64	25	5	32.3	......	27	46	6	6	28.9	......
Oneida	4	67	25	8	35.0	8.90	22	48	6, 7	12	30.0	4.82
Depauville	4	63	25	6	32.4	5.42	26	47	7	1	27.5	4.38
Oswego	4	62	25	15	35.4	2.93	10	49	7	13	30.7	4.60
Palermo	4	60	25	5	32.2	3.10	26	45	7	5	27.1	3.98
North Volney	4	65	25	11	34.3	......	26	47	7	8	28.9	......
Waterbury	4	66	25	8	34.9	......	26	44	3	9	28.6	......
Nichols	4	61	25	6	35.3	......	22	48	7	11	30.2	......
Newark Valley	4	65	25	0	34.1	2.70	22	48	10	6	28.9	3.29
Himrods	4	72	25, 26	21	34.3	4.94	22	45	7	11	28.6	3.38
Rochester	4	66	24	22	36.3	3.58	22	49	7	14	32.2	2.92
Little Genesee	4	66	25	2	30.3	3.00	16	46	7	— 2	28.1	2.50
Suspension Bri'ge	11	63	25	16	36.7	......	22	48	7	14	32.0	......
Buffalo	4	68	25	16	35.2	3.25	26	50	7	13	31.2	3.09
Averages	......	......	......	......	35.4	3.73	......	......	......	......	29.9	4.28
NEW JERSEY.												
Paterson	4	61	26	24	38.2	4.00	22	55	10	7	32.8	5.96
Newark	4	60	25	25	38.9	3.09	1	49	10	10	33.2	5.44
New Brunswick	30	58	25	24	35.8	3.11	22	56	10	7	33.5	4.21
Trenton	4	59	25	25	41.9	4.22	16	52	10	10	37.3	6.37
Rio Grande	3	62	26	21	40.3	4.13	31	56	4	15	36.6	6.13
Moorestown	4, 30	59	25	23	38.6	3.75	22	58	10	7	34.2	4.54
New Germantown	4	62	25	21	36.4	3.24	1	57	10	5	31.6	4.56
Lesser Cross R'ds	4	60	25	22	40.1	......	22	52	10	6	32.7	......
Haddonfield	30	59	22, 25	24	38.5	3.87	28	57	10	6	34.7	4.81
Newfield	4	66	10, 24 25, 28	22	33.3	......	22	60	10	5	35.5	......
Greenwich	4	58	25	26	40.1	3.48	16	54	7	14	37.2	4.21
Vineland	4	63	1	20	39.0	4.42	22	58	7	8	35.9	4.88
Averages	......	......	......	......	38.8	3.73	......	......	......	......	34.6	5.11
PENNSYLVANIA.												
Nyces	4	58	19, 25	14	32.3	3.51	11	48	9	— 9	28.7	4.96
Hamlinton	5	60	24	21	36.7	3.40	12	47	10	6	30.9	3.95
Dyberry	4	67	25	13	33.2	2.86	11	48	10	— 2	27.6	4.50
Fallsington	4	57	25	25	39.0	3.70	22	56	10	8	35.0	5.20
Philadelphia	30	58	25	30	41.3	3.20	22	56	7	18	37.7	4.35
Germantown (M)	30	59	10, 25	24	38.0	......	22	58	7	11	34.2	......
Do ...... (T)	5	53	25	29	41.7	......	22	56	7, 10	15	34.7	9.60
Horsham	4	60	25	25	37.6	4.50	22	55	10	8	33.6	5.45
Plym'th Meeting	4	60	13, 25, 26	26	38.1	4.06	23	55	10	3	34.2	5.55
White Hall	5	58	19	22	37.2	......	28	49	10	1	32.8	......
Factoryville	4	61	25	13	34.1	2.41	22	48	10	3	28.7	4.82

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
PA.—Cont'd.		Deg.		Deg.	Deg.	In.		Deg.		Deg.	Deg.	In.
Reading	5	61	25	27	40.2	1.81	22, 28	51	10	11	36.3	5.44
Parkersville	5	60	26	24	38.2	4.05	22	56	10	8	34.5	4.30
West Chester	4	60	25	24	37.3	3.85	22	53	7	10	33.9	4.98
Ephrata	4	66	25	26	40.5	3.19	22	50	10	8	35.8	5.87
Mount Joy	4	59	1	26	38.3	......	31	55	10	10	36.9	......
Harrisburg	5	61	8, 22	30	40.3	2.22	1	56	7	18	37.2	6.98
Carlisle	4, 5	69	22, 25	26	38.7	2.70	31	51	10	12	34.2	8.10
Fountain Dale	4	58	25	23	36.2	2.72	16, 31	47	7	18	33.0	8.53
Tioga	4	66	25	10	35.1	2.90	12, 22	46	7	— 2	29.7	4.29
Lewisburg	4	56	22	21	35.1	2.57	16	44	10	4	29.7	3.25
Grampian Hills	4	66	22, 25	4	28.3	3.27	11	46	7	2	26.1	4.95
Johnstown	4	64	25	11	33.5	4.07	11	47	25	10	31.3	4.47
Franklin	4	67	22	10	33.5	4.52	26	49	7	4	31.5	4.12
Connellsville	4	69	25	10	34.7	......	22	60	9	10	33.2	......
Brownsville	4	68	25	20	39.1	......	22	58	......	......	36.8	......
New Castle	4	61	25	15	34.3	......	27	50	7	11	31.8	......
Beaver	4	65	11, 25	23	37.9	4.20	11	52	7	16	36.0	4.80
Canonsburg	4	69	25	16	36.1	2.35	11	64	7	8	34.3	2.32
Averages	......	......	......	......	36.8	3.28	......	......	......	......	33.1	5.24
DELAWARE.												
Milford	4, 30	62	25	23	39.1	3.50	22	62	7	16	33.0	4.30
MARYLAND.												
Woodlawn	5	62	25	24	38.3	4.20	12, 31	56	7	12	34.8	6.00
Annapolis	4, 5, 30	60	12, 22, 25	25	42.8	3.51	22	58	7	17	40.2	6.15
St. Inigoes	5	63	24	25	42.3	2.51	22	61	9	23	47.2	......
Frederick	5	62	8	29	41.6	1.99	1	62	10	23	38.7	6.31
Mt. St. Mary's	5	59	25	25	37.3	2.93	31	50	3	19	33.8	7.49
Averages	......	......	......	......	40.5	3.03	......	......	......	......	38.9	6.49
DIST. COLUMBIA.												
Washington	5, 30	58	8, 12, 22, 25	29	40.7	1.68	12	58	7	24	38.7	5.21
VIRGINIA.												
Johnsontown	4	64	26	27	43.4	2.25	1, 12, 22	60	4	23	43.4	2.55
Hampton	17	64	22	27	43.5	1.20	12	61	4	24	42.5	3.55
Zuni Station	17	66	12	26	42.1	1.42	22	63	10	24	44.4	4.53
Bacon's Castle	5, 17	65	12	24	43.3	......	22	64	4, 10	22	43.5	......
Comorn	5	65	8, 22, 25	28	41.7	1.81	1	68	4	23	39.8	2.90
Vienna	5	66	22, 28	27	41.2	1.50	31	57	3, 4, 7, 9, 24	25	38.5	7.10
Piedmont	5	63	9, 22	23	41.9	1.80	12	58	24	16	36.4	5.30
Piedmont Stat'n	5	62	16	22	38.5	1.80	12	64	10	18	35.8	6.40
Staunton	4	63	8	28	40.2	1.06	11	56	9, 24	21	37.4	5.13
Lexington	4	70	12, 22	20	40.8	1.38	1, 11, 12	60	9, 24	16	39.1	5.47
Lynchburg	4, 5, 30	61	22	29	43.4	......	12	58	24	27	41.2	......
Snowville	4	68	25	13	35.8	3.37	1, 11, 22	56	9, 24	10	33.3	8.70
Near Wytheville	3	65	25	18	36.3	1.60	12	53	24	13	34.0	4.10
Averages	......	......	......	......	40.9	1.74	......	......	......	......	39.2	5.07
WEST VIRGINIA.												
Weston	......	......	......	......	......	......	11	60	24	11	34.5	......
Cabell C. H	4	54	14	33	40.2	2.30	27	56	24, 29	24	37.2	1.30
NORTH CAROLINA.												
Kenansville	30	70	8	26	47.2	......	12	72	8, 9, 10, 11	28	49.7	......

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
N. CAR'A—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Goldsboro	30	74	26	27	47.4	3.15	1, 12, 28	69	4, 10	25	48.3	4.95
Mt. Olive	30	64	22	24	44.4	2.00	2	82	31	29	56.5	2.50
Oxford	......	......	......	......	......	......	12, 22	62	10	22	43.0	4.20
Chapel Hill	27	72	25	30	51.4	......	1	75	10	23	48.1	......
Albemarle	5	72	1	18	41.0	4.00	1, 12	63	9	14	41.1	7.09
Statesville	5	64	8, 22	18	38.3	3.00	......	......	......	......	......	......
Asheville	2	64	1, 22	24	40.7	2.30	22	60	9	15	37.5	5.60
Do	2	64	1	24	41.4	......	22	60	9	14	37.2	......
Averages	......	......	......	......	44.0	2.89	......	......	......	......	45.2	4.87
SOUTH CAROLINA.												
Aiken	30	71	21	30	47.4	2.76	12	67	19	30	47.1	4.58
Gowdeysville	3	67	22	27	47.5	3.85	1, 12	68	10	22	43.6	6.97
Averages	......	......	......	......	47.5	3.31	......	......	......	......	45.4	5.78
GEORGIA.												
Berne	16	76	21	29	51.1	0.75	1	76	19	27	49.4	5.00
Penfield	5	70	22	30	48.5	4.45	1	63	10	27	44.2	5.12
Atlanta	4	69	22	26	45.3	6.03	12	60	19, 23, 31	23	39.6	6.69
Averages	......	......	......	......	48.3	3.74	......	......	......	......	44.4	5.60
ALABAMA.												
Opelika	4	76	21	29	52.6	4.19	13	67	23	27	42.5	9.25
Carlowville	4	74	20	32	48.1	5.93	12	68	23	28	47.2	6.71
Moulton	4	64	1, 20	30	46.8	4.83	11, 14	53	23	26	41.5	5.76
Greene Springs	30	73	20	30	50.6	5.10	12, 13	63	23	25	44.4	4.20
Havana	30	77	21	28	53.0	4.30	11, 13	66	23	26	45.5	5.90
Fish River	6	76	21	36	......	3.00	......	......	......	......	......	......
Mobile	4	75	1, 7	38	55.4	3.32	21	70	23	30	51.0	4.18
Averages	......	......	......	......	51.1	4.37	......	......	......	......	45.4	6.00
FLORIDA.												
Port Orange	16	81	21	36	60.8	......	1	81	19	33	58.3	......
Jacksonville	16, 30	78	22	34	58.5	1.65	1	78	19	34	55.8	3.50
Pilatka	16	82	21	36	60.1	2.06	1	82	19	34	57.2	4.52
Ocala	5, 12, 15, 16	86	21	32	68.0	......	2	89	8	26	58.2	......
Manatee	29	94	22	38	66.8	2.70	1	84	19, 31	43	64.0	3.10
Chattahoochee	28	79	20	39	......	1.80	18	74	21	32	......	1.00
Averages	......	......	......	......	62.4	2.05	......	......	......	......	58.7	3.03
TEXAS.												
Gilmer	15	83	17	31	58.3	2.59	7	68	23	19	44.2	4.72
Palestine	4, 15	84	24	39	63.5	......	10	71	23	22	47.5	7.10
Houston	12, 14, 21	84	16, 17	38	65.2	......	4, 19, 31	69	23	27	49.6	......
Blue Branch	2, 4	84	17, 24	36	64.6	1.60	10	72	23	22	47.0	3.10
Lavaca	5	86	17	42	66.6	0.40	9	78	22	28	52.1	2.00
Austin	4	82	24	36	62.5	1.54	10	72	22	19	46.6	1.32
Clinton	5, 22	86	17	42	66.9	0.25	9, 10	75	23	26	50.5	0.74
Averages	......	......	......	......	63.9	1.28	......	......	......	......	48.2	3.19
LOUISIANA.												
Benton	9	82	21, 24	32	56.7	......	......	......	......	......	......	......

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER.						DECEMBER.					
	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MISSISSIPPI.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Columbus	4	71	20	29	49.5	5.65	14	61	23	24	43.7	5.73
Marion C. H.	26	82	18	30	56.2	5.70	12	76	15, 29	24	49.8	5.20
Paulding	5	78	11	34	55.1		.....	.....	.....	.....	.....	.....
Grenada	4	76	21	27	51.6	5.15	10, 11, 31	60	23	20	44.6	7.40
Near Brookhaven	4	75	1, 25	38	59.2	5.40	10, 12	70	22	25	50.5	8.50
Natchez	4, 29	72	20, 24	32	50.9	6.04	10, 11	66	23	24	47.7	8.54
Averages	.....	.....	.....	.....	53.8	5.59	.....	.....	.....	.....	47.3	7.07
ARKANSAS.												
Helena	29	72	20	27	50.0	.....	12	63	23	20	43.7	.....
TENNESSEE.												
Elizabethton	3	72	1, 8, 21, 22, 25	22	41.7	2.73	27	60	9	16	37.7	3.60
Tusculum College	30	68	8	24	41.8	1.50	13, 26	52	24	24	37.5	3.40
Lookout Mount'n.	2	72	20	29	45.6	.....	12	61	23	19	40.7	.....
Austin	4, 29	70	23	26	43.7	5.17	11	62	23	20	38.8	3.94
Clarksville	4	73	18	28	42.7	3.40	11	57	23, 24	23	37.5	4.14
Trenton	4, 26	70	7	27	47.0	5.50	7	62	24	21	41.4	5.30
Memphis	4	72	21	26	46.3	4.84	11	57	23	20	39.6	4.68
Knoxville	4	69	1, 25	25	42.3	3.00	27	62	9	23	39.3	4.30
Averages	.....	.....	.....	.....	43.9	3.73	.....	.....	.....	.....	39.1	4.19
KENTUCKY.												
Pine Grove	4	70	8	18	39.1	4.09	4	56	24	18	36.0	3.85
Danville	3, 4	74	8	25	45.5	2.13	4, 31	55	24	20	39.8	3.18
Shelby City	4	70	8, 15	22	40.9	3.20	11, 27	53	24	19	37.2	3.28
Louisville	4	72	15	27	42.5	4.81	11	57	20, 22	28	39.7	1.63
Near Louisville	4	71	11, 15	21	40.7	5.95	11	54	23	22	36.1	2.88
Averages	.....	.....	.....	.....	41.7	4.04	.....	.....	.....	.....	37.8	2.96
OHIO.												
Steubenville	4	59	8, 11	23	37.3	2.71	22	54	7	15	35.7	3.32
Painesville	.....	.....	.....	.....	.....	.....	11	47	3, 21	20	31.9	3.33
Gilmore	.....	.....	.....	.....	.....	.....	27	56	3, 7	16	34.0	6.10
Milnersville	4	64	7, 8	14	35.1	3.20	11	53	7	5	32.1	.....
Cleveland	3	70	24, 25	17	35.0	3.58	11	49	20	19	32.4	3.08
Wooster	3	72	11	17	35.9	2.87	.....	.....	.....	.....	.....	.....
Gallipolis	4	73	2, 8, 25, 28	24	36.3	3.26	4, 27	52	9, 24	18	35.9	2.81
Kelley's Island	3, 4	60	7, 21	26	36.5	3.55	11, 15, 31	42	3	19	32.3	1.99
Sandusky	3	67	25	22	36.4	4.26	11	47	3, 20	18	33.6	2.46
North Fairfield	4	64	25	18	35.6	4.52	11	48	3	16	32.5	3.69
Westerville	4	67	11	19	36.3	4.22	31	50	20	19	33.9	3.06
New Holland	.....	.....	.....	.....	.....	.....	11	62	3, 18	20	38.4	5.11
North Bass Island	3	68	7	23	36.5	4.87	31	45	3	17	31.5	2.42
Marion	4	66	11	17	34.1	4.95	26	48	3	12	31.1	3.60
Hillsboro	4	65	8	20	36.3	4.43	11	50	3	19	32.6	2.93
Toledo	3	70	24	16	34.8	4.56	15, 31	45	3	13	31.4	2.46
Bowling Green	3	72	24	6	35.5	6.45	31	48	3	10	32.4	2.05
Kenton	4	69	8	19	39.5	3.04	26	54	23	19	38.0	3.63
Urbana	3, 4	67	11	16	34.5	4.21	26	49	3	15	31.5	3.12
Bethel	4	69	8, 15	22	36.0	3.88	11	52	24	18	43.6	2.50
Jacksonburg	3	68	15	20	37.3	4.04	26	47	3	19	33.3	3.81
Mt. Auburn Inst	30	57	28	26	38.2	3.96	11	52	3, 20, 24	22	34.7	3.70
Cincinnati...(H)	4	71	28	23	38.6	3.30	15	52	3, 24	20	34.6	2.46
Do.......(P)	4	70	15	26	41.0	3.16	12, 15	51	20, 24	26	38.6	3.50
College Hill	4	70	15, 28	22	38.5	2.89	11	48	3	19	32.7	5.63
Averages	.....	.....	.....	.....	36.7	3.91	.....	.....	.....	.....	34.1	3.38

Meteorology of 1869—Continued.

Stations in States and Territories.	November. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	December. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MICHIGAN.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Monroe City	3	68	24	10	38.2	1.90	30	43	20	16	31.1	2.00
Adrian	3	69	23	0	30.8	8.20	11	49	3	6	25.8	4.44
Alpena	4	58	7	20	33.5	1.20	11	38	24	16	29.2	2.14
State Ag'l College	3	71	24	4	32.1	1.93	26	45	3	0	28.2	2.11
Litchfield	3	65	24	0	31.4	3.63	26	43	3	6	27.7	2.70
Coldwater	3	66	24	6	32.8	3.53	26	47	3, 8	10	27.7	4.23
Grand Rapids	3	69	21	17	33.8	......	11	43	24	13	28.6	......
Northport	3	66	7	22	33.1	3.50	25	42	24	15	27.7	3.16
Pleasanton	3	58	24	17	30.6	5.75	9, 10, 26	39	23	11	25.6	4.25
Muskegon	3	68	21	20	38.8	3.45	10, 11, 26, 27, 29	46	20, 21	16	31.9	6.20
Otsego	5	60	25	30	40.3	......	9	51	26	16	36.5	......
Copper Falls	3	68	21, 23	13	27.2	2.75	9	35	23	— 4	18.6	4.65
Ontonagon	3	60	24	16	32.8	......	10	42	24	— 2	25.0	......
Homestead	......	......	......	......	......	......	10	41	24	14	28.0	......
Averages	......	......	......	......	33.5	3.58	......	......	......	......	28.0	3.59
INDIANA.												
Aurora	4	72	15	19	38.5	4.04	11	53	24	15	33.9	3.34
Vevay	4	71	15	21	39.6	4.74	11	51	24	18	35.7	3.47
Mount Carmel	3, 4	68	8, 21, 23	24	36.9	4.02	11	47	20, 22, 23	22	33.2	2.35
Muncie	3	66	15, 24	17	35.2	3.90	10, 26	50	3	11	32.2	2.60
Spiceland	3	64	15	18	35.8	2.65	11	48	3	13	31.0	2.50
Laconia	4	73	15, 18	25	40.2	5.09	11	55	24	21	35.6	2.87
Columbia City	3	65	24	16	37.9	1.88	11	51	3, 23	15	32.4	1.63
Knightstown	3	66	28	18	35.5	6.81	11	48	3	13	31.3	3.36
Indianapolis	2, 4	60	15, 28	18	35.4	4.66	11	49	3, 24	14	32.4	2.42
Bloomington	3, 4	62	15	20	37.4	4.64	......	......	......	......	......	......
La Porte	3	66	28	12	34.0	4.05	11	47	20	2	28.0	2.60
Rensselaer	3	65	14, 25, 28	20	33.7	5.20	11	45	23	5	26.1	2.35
Lafayette	......	......	......	......	......	......	14, 15	46	3, 20	10	30.6	4.50
Merom	4	66	7, 14	24	32.5	4.97	11	50	20	19	32.3	2.55
Kentland	2	68	18, 20	20	35.2	5.05	......	......	......	......	......	......
New Harmony	2	67	7, 14	27	40.4	4.98	11	54	20, 23	18	35.0	2.58
Harveysburg	3	66	7, 15, 28	20	37.4	3.70	11	50	20	6	31.7	2.70
Averages	......	......	......	......	36.9	4.40	......	......	......	......	32.1	2.79
ILLINOIS.												
Chicago	3	63	20	25	36.5	2.42	10, 15	46	20	10	30.6	2.04
Near Chicago	3	62	28	16	32.0	......	10, 11	42	3, 20	8	26.9	......
Evanston	3	59	21	18	33.7	4.49	10	45	20	8	27.9	2.99
Marengo	3	61	21	6	30.0	2.39	11	48	20, 23	1	24.3	2.60
Mattoon	2	72	7, 14	24	38.5	4.16	30	49	20	8	32.5	3.31
Aurora	......	......	......	......	......	......	11	43	20	3	25.1	3.13
Louisville	2, 4	70	7, 14	20	39.2	6.80	11, 29	50	20	8	34.8	3.80
Golconda	3	68	19	19	43.6	1.10	14	62	23	10	38.1	3.97
Belvidere	2	65	23	— 2	29.7	2.50	10, 26	42	23	— 3	24.1	2.71
Sandwich	2	63	24, 28	8	29.6	3.18	10, 11	46	20, 23	2	26.1	3.17
Ottawa	2	69	20	18	35.1	1.88	10	50	20	9	31.4	1.64
Decatur	2	72	20	18	35.2	4.95	29	48	23	6	29.9	3.65
Pana	2	70	7, 14, 18, 20	22	36.8	4.55	29	48	20	6	30.8	2.50
Winnebago	2	61	24	4	29.3	2.76	10	41	20	— 3	23.3	2.86
Rochelle	3	65	21	6	31.4	......	10	45	20	0	26.9	......
Wyanet	2	68	23	5	33.9	3.88	10, 26	48	20	— 1	28.0	3.02
Tiskilwa	2, 3	58	21, 24	14	34.5	......	11	48	20	4	29.3	3.30
Hennepin	2	67	20	12	35.0	......	10	50	20	— 5	29.0	......
Peoria	2	63	21	14	35.6	3.13	10	48	20, 28	4	30.5	2.63
Springfield	3	69	21	18	37.1	......	11	50	20	5	29.9	......
Dubois	3	72	15, 20	22	39.3	4.60	30	54	23	4	32.0	2.11
Waterloo	2	66	20	25	42.3	4.30	......	......	......	......	......	......
Galesburg	1	61	24	10	33.0	2.80	30	49	20	0	32.8	2.00
Manchester	2	69	20	17	37.8	2.89	29	52	19	12	30.7	2.87

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
ILLINOIS—Cont'd.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
Mount Sterling	6	70	20	12	34.6	4.70	10, 24	48	20	0	28.3	2.70
Andalusia	2	60	21	12	35.1	......	10	54	20, 21	— 6	28.8	......
Augusta	2	65	21	11	35.4	3.43	10	53	20	— 3	26.4	2.08
Warsaw	5	89	20	16	36.3	3.71	24	58	20, 23	0	29.1	2.19
Averages	......	......	......	......	34.9	3.48	......	......	......	......	29.2	2.79
WISCONSIN.												
Manitowoc	3	56	21, 24	12	32.5	3.15	10, 31	41	24	— 2	25.7	2.79
Plymouth	3	63	24	4	30.9	3.70	10	44	3	— 1	21.0	2.50
Hingham	3	68	24	2	31.3	......	10	47	3	— 1	24.5	......
Milwaukee	3	62	24	14	32.9	3.35	11, 12	45	24	1	26.4	2.79
Appleton	3	60	24	12	33.0	......	10, 27	42	24	— 2	25.6	......
Geneva	2	64	24	9	31.5	2.75	11	44	3, 22, 23	6	24.6	2.55
Waupacca	3	61	21, 28	15	32.5	......	10	40	24	—16	23.9	......
Embarrass	3	58	24	5	28.9	2.66	10, 27	36	24	—17	21.9	3.65
Rocky Run	2, 3	58	24	1	31.1	2.38	10	41	20	— 6	22.5	2.38
Madison	3	60	24	12	30.4	1.97	10	40	23	— 3	22.3	2.64
Edgerton	1, 2, 3	62	24	0	32.8	2.50	10, 11, 26	44	20, 23	2	25.6	3.40
Baraboo	3	49	22	0	28.8	9.25	10, 27	36	20, 21, 23	0	21.3	5.50
New Lisbon	3	65	24	—4	35.1	......	10, 26	45	20	—10	22.3	......
Bayfield	4	68	23	8	29.5	......	9, 27	38	23	—12	19.3	......
Averages	......	......	......	......	31.1	3.52	......	......	......	......	23.4	3.13
MINNESOTA.												
Beaver Bay	2	64	30	6	30.8	0.39	10	45	23	—10	20.5	0.90
Afton	3	66	21	2	28.3	0.90	10	40	23	—16	19.0	0.85
St. Paul	3	65	21	6	30.1	0.75	10	41	23	—10	20.8	0.96
Minneapolis	3	67	21	2	27.5	0.68	9	39	23	—18	18.1	0.95
Sibley	3	68	3	1	27.3	1.01	9	41	23	—17	17.7	0.48
New Ulm	3	70	30	1	28.8	0.60	9	42	23	—14	20.5	0.50
Madelia	3	70	30	— 2	27.9	1.46	9	42	23	—20	20.4	1.28
White Earth	2	67	30	— 6	23.9	0.80	8	41	23	—28	14.1	0.93
Averages	......	......	......	......	28.1	0.81	......	......	......	......	18.9	0.86
IOWA.												
Clinton	2	62	19	2	31.1	3.10	6	48	20, 23	0	24.0	2.50
Waukon	2	62	21	4	29.2	......	10	40	23	—12	20.1	......
Dubuque	3	60	21	8	31.7	1.69	10, 11	44	23	0	25.4	2.64
Monticello	1	66	24	10	30.9	2.65	25	38	22	— 4	21.1	2.25
Bowen's Prairie	2	62	20	6	29.9	2.15	10	43	23	— 8	23.7	3.43
Muscatine	1, 3	56	21	3	32.6	......	......	......	......	......	......	......
Fort Madison	3	67	20, 21	14	35.6	3.31	10	51	23	0	28.5	2.39
Guttenberg	2	61	21	— 4	29.1	......	26	42	24	—12	21.2	......
Mount Vernon	2	62	21	5	31.0	......	10	46	20	— 3	24.6	......
Iowa City	1	70	21	5	32.1	4.49	10	46	20, 23	— 2	25.5	3.00
Independence	2	66	21	— 1	29.9	1.55	10	44	23	—13	22.6	8.50
N'r Independence	......	......	......	......	......	......	11	44	23	—10	19.2	5.20
Waterloo	2	68	21	0	30.6	......	10	44	23	—10	23.3	......
Vinton	2	69	21	5	31.3	2.50	10	49	23	— 6	24.4	4.06
Rockford	2	63	21	8	32.1	......	10	44	23	— 6	23.9	......
Newton	2	65	21	— 2	31.1	0.77	9	48	23	—10	22.2	1.02
Iowa Falls	2	64	21	2	30.8	9.05	9	43	23	— 8	25.2	3.66
Algona	3	57	21	3	29.4	......	9	42	23	—16	22.2	6.40
West Bend	2	63	21	0	27.0	......	9	40	23	—15	20.3	......
Boonsboro	2	63	21	2	30.1	1.30	3	46	23	— 8	25.2	1.70
Mineral Ridge	2	65	21	7	31.4	3.90	3	49	23	— 7	25.8	2.51
Fontanelle	2	62	21	8	30.7	2.30	3	53	23	— 2	28.5	2.73
Rolfe	2	66	21	— 5	28.9	2.14	9, 10	45	23	—12	24.5	0.64
Grant City	2	70	23, 30	6	29.2	1.75	7	48	23	—12	24.3	3.12
Logan	1	64	13	4	31.6	1.30	3	48	23	— 4	25.9	2.70
Woodbine	5	72	13	4	34.5	......	6	45	23	— 6	24.6	2.10
West Union	1	71	21	— 1	30.7	0.84	30	46	23	—13	22.5	2.24
Averages	......	......	......	......	30.9	2.63	......	......	......	......	23.8	3.09

Meteorology of 1869—Continued.

Stations in States and Territories.	NOVEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.	DECEMBER. Date.	Maximum temperature.	Date.	Minimum temperature.	Mean temperature.	Rain and melted snow.
MISSOURI.		*Deg.*		*Deg.*	*Deg.*	*In.*		*Deg.*		*Deg.*	*Deg.*	*In.*
St. Louis	2	68	20	25	41.1	4.75	29	55	20	13	34.6	1.83
Allenton	1, 2	74	7, 20	20	39.8	5.66	29	62	23	6	33.0	2.70
Hematite	2	77	7	18	41.1	5.20	29	63	23	— 4	35.2	2.25
Rolla	2, 4	70	7, 21	21	40.2	5.05	29	61	23	2	34.7	1.62
Jefferson City	1	68	21	21	44.0	......	29	56	20	9	32.0	......
Hermitage	1	74	24	16	39.3	3.25	10	53	23	4	31.2	2.40
Bolivar	1, 4	68	19, 20	23	39.4	6.50	26	60	22	8	37.3	4.40
Harrisonville	1	68	21, 24	22	38.5	1.60	9, 10	54	20, 23	0	30.1	1.62
St. Joseph	4	62	21	18	......	......	3	56	23	4	31.8	2.20
Oregon	1	64	21	14	36.5	1.49	3	62	20	0	29.9	3.43
Averages	......	......	......	......	40.0	4.19	......	......	......	......	32.0	2.49
KANSAS.												
Atchison	3	68	21	18	36.7	2.20	10	56	23	— 4	29.9	1.65
Leavenworth	2	68	21	16	36.1	2.33	3, 10	55	23	— 8	28.5	1.33
Olathe	1	69	21	18	36.9	1.70	3, 10	55	23	0	29.9	0.90
Paola	2	75	21	18	36.6	2.11	8, 10	56	23	4	31.7	1.35
Baxter Springs	2	72	21	22	45.7	3.00	8, 10	60	22	6	33.4	3.30
Lawrence	1	70	20	25	42.4	1.86	3	63	23	4	36.9	0.87
Holton	3	66	30	18	36.4	......	3	59	22	0	29.7	......
Neosho Falls	1	70	21	17	37.8	1.10	10	55	22, 23	— 2	26.4	1.20
Le Roy	4	64	22	22	47.6	1.92	10	59	22	2	32.8	2.92
State Agr. College	3	65	19, 30	20	37.3	1.19	9	58	22	— 3	31.2	0.52
Council Grove	3	71	21	22	41.1	1.80	9	62	23	— 4	35.2	0.90
Crawfordsville	1	72	20	22	43.6	3.55	10	60	20	— 3	31.9	4.20
Averages	......	......	......	......	39.9	2.07	......	......	......	......	31.5	1.74
NEBRASKA.												
Omaha Mission	3	70	30	9	32.9	1.50	9	58	23	— 5	28.5	2.36
Elkhorn	2	62	30	11	32.6	......	9	52	23	— 3	25.8	......
De Soto	1	59	30	9	31.5	1.13	9	52	23	— 5	24.7	4.26
Fontanelle	1, 3	62	30	10	......	2.50	......	......	......	......	......	......
Bellevue	1	63	13, 30	16	35.2	1.40	3	55	23	2	28.4	2.20
Nebraska City	2, 4, 5	60	30	15	34.8	2.05	3	54	20, 23	— 2	27.7	2.28
Averages	......	......	......	......	33.4	1.72	......	......	......	......	27.0	2.78
UTAH TER.												
Salt Lake City	3	65	2	22	42.8	......	25	52	21, 22	12	30.6	0.00
Coalville	6	65	27	5	39.2	......	3, 8	43	21	—14	20.6	0.25
Averages	......	......	......	......	41.0	......	......	......	......	......	25.6	0.13
CALIFORNIA.												
Monterey	6	77	26, 27, 30	35	55.1	0.72	3, 6, 17, 18	65	21	27	48.9	2.42
Chico	5, 6	76	30	30	55.8	2.05	17	69	22	25	46.0	3.40
Vacaville	4	78	30	39	60.6	2.44	5	76	21	29	43.5	4.43
Watsonville	4, 19	84	27	31	55.6	0.16	2, 14, 15, 16, 17	70	21	28	46.8	3.52
Cahto	......	......	......	......	......	......	2	65	21, 22	31	46.2	......
Averages	......	......	......	......	56.8	1.34	......	......	......	......	46.3	3.44
MONTANA TER.												
Deer Lodge City	1, 2	68	15	8	34.1	1.59	3	46	19	— 3	24.1	0.56
WASHINGTON TER.												
Port Angeles	22	59	17	41	49.5	20.70	12	52	20	38	46.3	11.75
Walla-Walla	19	62	27	27	45.0	......	13	58	22	16	34.6	5.68
Averages	......	......	......	......	47.3	......	......	......	......	......	40.5	8.72

STATE AVERAGES FOR THE YEAR 1869.

Table showing the highest and the lowest range of the thermometer, (with dates prefixed,) the average mean temperature, and the average rain-fall, (including melted snow;) also, the months with amounts of the greatest and least rain-fall in each State named, for the year 1869. Hours of observation, 7 o'clock a. m. and 2 and 9 o'clock p. m. Compiled from the preceding tables.

States.	Average number of stations.	Date.	Highest temperature.	Date.	Lowest temperature.	Average mean temperature.	Average rain-fall.	Greatest rain-fall.		Least rain-fall.	
								Month.	Am't.	Month.	Am't.
			Deg.		*Deg.*	*Deg.*	*In.*		*In.*		*In.*
Maine	9.0	July 3	92	January 19, 20	—26	44.0	4.35	October	12.11	August	1.93
New Hampshire	4.3	May 12	90	January 19	—30	43.4	3.93	October	12.07	July	1.48
Vermont	8.8	June 4 July 23	91	March 5	—29	42.9	4.05	October	10.79	November	1.67
Massachusetts	15.0	May 12 June 11, 16, 27 August 20	96	March 2	—11	47.1	4.25	October	8.44	August	2.03
Connecticut	4.8	July 9	98	March 2, 5	— 6	46.9	5.01	October	12.29	April	2.04
New York	31.0	August 20	100	February 28 March 5	—18	46.7	4.12	October	7.23	April	2.15
New Jersey	11.4	July 16 August 21	102	March 1	— 2	51.8	3.89	October	6.81	August	1.36
Pennsylvania	28.0	August 21	105	January 23	—12	49.5	3.95	October	5.61	April	2.04
Maryland	4.5	July 16	97	March 5	— 8	53.9	4.02	December	6.49	August	1.31
Virginia	11.5	July 11 August 20	104	March 7	— 1	55.1	3.58	May	5.89	August	1.35
West Virginia	2.3	July 15, 16 August 21	102	February 6 March 7	4	53.0	2.20	June	5.30	October	1.10
North Carolina	8.5	July 17	107	March 7	8	58.6	4.01	February	6.66	October	2.43
South Carolina	2.5	July 14	101	March 1	16	62.0	3.60	February	6.09	October	1.87
Georgia	3.7	July 11 August 21	103	February 24, 28 March 1	16	61.1	3.93	February	6.90	October	1.55
Alabama	5.3	August 22	105	February 28 March 1	20	62.0	4.58	February	8.32	May	1.78
Florida	5.4	July 4, 13	102	December 8	26	70.8	4.23	July	7.57	May	1.11
Texas	6.5	July 15, 16, 17, 18, 20	95	December 22, 23	19	66.8	3.93	July	9.16	November	1.28
Mississippi	5.7	July 13 August 22, 23	102	February 28	18	63.1	5.50	April	11.00	May	1.98
Tennessee	6.5	August 23	102	March 7	6	57.2	3.67	April	5.96	September	2.14
Kentucky	4.3	August 24	99	January 12 February 5	6	55.0	3.57	June	4.57	October	2.11

State averages for the year 1869—Continued.

States.	Average number of stations.	Date.	Highest temperature.	Date.	Lowest temperature.	Average mean temperature.	Average rain-fall.	Greatest rain-fall.		Least rain-fall.	
								Month.	Am't.	Month.	Am't.
			Deg.		*Deg.*	*Deg.*	*In.*		*In.*		*In.*
Ohio	24.0	July 16	101	March 1	— 6	50.8	3.67	May	6.14	August	1.69
Michigan	13.0	August 10	98	February 27	—24	44.6	3.22	June	5.65	January	1.97
Indiana	15.0	August 19, 23, 24, 25	100	January 10	—12	50.9	3.94	July	6.41	October	1.88
Illinois	27.0	August 26	105	January 5	— 8	49.0	3.71	May	8.26	October	1.30
Wisconsin	13.0	July 24	95	January 11	—18	43.6	3.71	June	8.94	March	1.05
Minnesota	8.3	August 4, 18	94	December 23	—28	41.1	2.69	September	9.72	January	0.38
Iowa	24.0	August 3, 4	98	January 11	—24	45.2	4.05	July	7.80	October	1.31
Missouri	11.0	August 23	101	February 23	— 5	53.3	3.48	June	7.02	February	1.69
Kansas	11.0	August 25	104	February 23	— 9	52.0	3.39	June	7.98	February	1.16
Nebraska	7.5	August 4	99	February 4	—10	47.8	3.51	August	7.38	March	0.57
California	3.6	September 25	101	January 16, 19, 20	23	58.7	1.99	January	5.34	June; Aug	0.00
District of Columbia	1.0	August 22	98	March 7	16	54.9	3.43	October	7.33	November	1.68

INDEX.

A.

Page.

Abortion 38
Acarus of sheep scab 386
remedies for 387
symptoms of 387
Acclimation in Australia 630
Action of atmospheric pressure upon vegetables 108
dew upon vegetables 128
electricity upon the germination and growth of plants 152
gravity upon vegetables 106
light in the production of chlorophyl and amidon 148
light on the germination and growth of plants 134
mist upon vegetables 132
nocturnal cooling and diurnal heating of cultivated soils 122
solar radiation upon vegetables 118
Adulteration of feed-stuffs and of manures 77
A few facts in sheep-husbandry 378
Aging wine 68
Agricultural capabilities of the Territories 601
colleges 452
congress in Paris 626
distilleries 340
education in Germany 450
exports 54
facts of the year 428
implements, direction of improvements in 318
in South Carolina 530
manufacture of, in Wisconsin 538
meteorology 97
museum in Iowa 544
patents of the year 315
qualitative and quantitative chemical analysis 509
societies, county and district, in Iowa 544
Agriculture at the base of the Rocky Mountains 94
southern 8
Alabama, crops of 27
mineral fertilizers of 550
Alcohol from beet root 339
Alsike clover in Maine 518
American Agricultural Annual 499
cattle farm 433
dairy factory system 355
dairying 352
Farm Book 495
hay, inferior condition of 442
Horticultural Annual 499
Institute Farmers' Club 416
Merino 378
steam plow 305
sumac 230
summer pearmain 185
Analyses of Alabama limestones 552
Arkansas limestones and tufa 560
fertilizers 428
guano 74
Illinois limestones 578
Indiana limestones and marl 571
Iowa limestones 580
Kentucky limestones and marls 566
marls 72
Michigan limestones and brines 574
mineral and well water 74
Minnesota limestones 583
Mississippi marls and limestones 555
Missouri limestones 562
Ohio limestones, marls, and gypsum 569
sea weeds 73
soils 71
sumac 65, 230
sweet potato 75
Tennessee marls 564

	Page.
Analyses of Vineland soil	411
white niter earth	550
wine	66
Wisconsin limestones	582
Angora goat	504
Annual report	14
Antisell, Thomas, Chemist, report of	65
Apple crop of Ohio	534
product of Indiana	541
tree, an astonishing	417
trees, neglected	417
Apples	184
fall	185
for the Southern States	184
in Western New York	445
summer	184
winter	187
Arboretum	91
Arizona, agricultural capabilities of	623
Arkansas, crops of	28
mineral fertilizers of	558
Valley, the upper	93
Arnautka wheat, tests of the	249
Aromatic Carolina	184
Artichoke	632
Ashes of bituminous coal, experiments with	296
for pasture lands	526
Aunt Peggie	194
Average value of farm products per acre	36
yield of farm products per acre	35
Ayrshire stock in Massachusetts	524

B.

Banana trees, fiber of the	266
Barberry bush for hedging	421
Barley and oats, experiments with	255
crop of 1869	24, 33
culture in Iowa	542
Probstier, tests of	255, 256
Saxonian, tests of	255, 256
Bee-hives, improvements in	331
Beet, preparation of the soil for	351
Beet-root culture, area devoted to, in France	341
experiments in removing leaves	337
in England	334, 337
France	336
profits of, in France	341
salt as a manure for	336
seed	351
soils for	337, 350
sugar, continental factories and farms	346
manufacture, improvements in	341
in Europe	334
Russia	344
Sweden	344
production in Europe	345
the United States	349
Beet, sugar, time for sowing seed of	338
varieties of	345
Belts or marginal plantations	170
Ben Davis	196
Binding machines, improvements in	327
Black leg	38
Blight in pear orchards	204
Bones, manure from	634
Bonum	186
Books of the year	487
Boran's Winter	187
Botanical collection	15
collection, addition to the	92
general character of the	91
of Dr. Edward Palmer	93
explorations	16, 93
Botanist, explorations by the	93
report of	91
Brie cheese	631
Broadnax	187
Bromalia karatas, fiber of the	266
pinguin, fiber of the	266
Buckingham	186
Buckwheat crop of 1869	24, 33, 35
Building site, selection of	163
Buildings and grounds, choosing a location for	162
Burridge's steam plow	309, 312
Butter-making	359
comparative profits of	370

Page.
Butter, Michigan ... 362
New York factory ... 360
Philadelphia ... 360, 422
the packing of ... 357, 366
the working of ... 367
western ... 367
whey ... 363
winter ... 366
Vermont ... 361
Byttneriaceous weed, the fiber of the ... 266

C.

Cabbage and turnip feeding ... 441
California, crops of ... 31
fruit shipments from ... 445
tea culture in ... 236
Camack's Sweet ... 187
Canadian reciprocity ... 7
Cane sugar production ... 56
Canning sweet corn ... 451
Capital in farming, advantage of ... 435
Capron, Horace, Commissioner of Agriculture, report of ... 5
Carriage turns and entrance gates ... 175
Castor bean in California ... 450
Cattle, diseases of ... 38
farm, an American ... 433
laws of the States ... 400
plague, Texas ... 540
sales, Madison County ... 371
transportation of ... 437
Census of 1870 ... 8
Charbon ... 39
Chemical and barnyard manures compared ... 292
division ... 14, 65
Chemist, report of ... 65
Cheese, American, in Europe ... 353
and butter factories in the United States ... 355
Brie ... 631
manufacture ... 352
western ... 357
trade in Chicago ... 441
Chicago live stock market ... 49
Chichiben, fiber of the ... 266
Churns, improvements in ... 333
Cider-makers' Manual ... 506
Cinchona ... 12
Clarke's pearmain ... 192
Classification of grapes ... 81
Clerical compensation ... 18
Climate, change of, destruction of forests ... 516
Clover and orchard grass in South Carolina ... 280
in Georgia ... 442
plaster and salt on ... 281
Coal ashes, bituminous, experiments with ... 296
Coffee with milk, deleterious effects of ... 634
Colonization, Vineland as a lesson in ... 410
Colorado Agricultural Society, report of ... 547
Territory, agricultural capabilities of ... 601
Commercial fertilizers, adulteration of ... 522
compared ... 285
experiments with ... 285, 291
manures, laws concerning ... 429
Commissioner's report ... 5
Concentrated root food ... 284
Connecticut, crops of ... 25
State Board of Agriculture, report of secretary of ... 525
Cooked food for swine ... 281
Cooking food, advantages of ... 439
Cornell University ... 470
courses in ... 474
degrees in ... 473
endowment ... 470
estate ... 471
library ... 471
museum ... 471
prizes in ... 473
Corn crop of Iowa ... 542
culture in Indiana ... 540
Massachusetts ... 524
South Carolina ... 530
drilling ... 540
effects of deep cultivation on ... 271
effects of superphosphate on ... 268
fodder, curing ... 295
feeding milch cows with ... 284
home-made fertilizers on ... 269

Page.
Corn huskers and shellers, improvements in 328
Indian, crop of 1869 .... 22, 24, 32, 35
experiments with 267
in Ohio 533
in drills and in hills 270
on prairie soil 270
swamp land 270
planters, improvements in 323
seed, selection of 271, 540
Correllation and conservation of forces applied to the vitality of seeds and growth of plants 100
Cotton crop of 1869 .... 22, 35
experiments in planting 291
with 281
gins, improvements in 330
lands, fertilized and unfertilized 290
manufacture in the South 9, 24
remarkable product of 290
seed meal for cows 284
for milch cows 440
in Egypt 441
seed, selection of improved 529
County agricultural societies in Massachusetts 524
Covered grape trellis 80
Cows and sheep, relative profits of 518
early cut hay for 285
milch, cotton-seed meal for 284, 440
feeding, with corn-fodder 284
Cow stables, temperature of 295
Cranberries, annual production of 206
picking and packing 212
Cranberry culture 204, 418
area devoted to, in New Jersey 212
expenses of 210, 211
profits of, in New Jersey 208, 209, 213
Culturist 507
insects injurious to the 207
lands, location, and area of, cultivated 205
wild, location of 206
prices of 211
product of the, per acre 211
the best soils for the 205
varieties of the 205
Cream, comparative yield of 367
Crops of 1869 .... 20, 24, 32, 35
Colorado 547
Cullasaga 196
Cultivators, improvements of 320
Culture and management of forest trees and native evergreens 493
steam, recent progress in 296
Cumming's Red 186
Curculio in Ohio 534
Curing corn-fodder 295
Currant bushes and sparrows 418

D.

Dairy business, fitness of the Alleghany Range for 356
cows, quality of 358
farm, large, in Missouri 439
farming, a field for 440
in Michigan 434
husbandry 533
John Johnson's 440
Dairying, American 352
vs. stock raising 437
Dairymen, directions for 422
Dakota Territory, agricultural capabilities of 606
Dead animals, what to do with 426
Deep cultivation, effects of, on corn 271
plowing, experiments in 295
Delaware, crops of 36
Department finances 19
grounds 18
seeds, distribution of 243
tests of 242
Diseases of cattle 38
horses 40
sheep 42
stock 13
swine 43
Disharoon 194
Distilleries, agricultural 340
Distribution of Department seeds 17, 243
Dodge, J. R., Editor, report of 157
Statistician, report of 20

	Page.
Donations to the Agricultural Museum	636
Drainage for fruit trees	446
results of	450

E.

Editor's report	157
Edwards	189
Eggs, importation of, into England	630
preservation of	630
Emigrant routes to Oregon	601
English experiments with mineral manures	273
Entomologist, report of	60
Entomology in Michigan	536
Entrance gates and carriage turns	175
Escrick farm, York, experiments	278
Excelsior oats, tests of	252
Exchanges, international	12
with foreign societies	256
Experimental Garden	17
Experiments at Michigan Agricultural College	279
Rothampsted, England	291
in deep plowing	295
destroying grubs and tobacco worms	296
feeding stock	281
feeding swine	282
planting cotton	291
subsoiling	287
miscellaneous	291
recent farm	267
uncertainty attending single	294
with bituminous coal ashes	296
clover and orchard grass in South Carolina	280
commercial fertilizers	285, 291
cotton	285
grass and hay	273
Indian corn	267
oats and barley at Agricultural College of Pennsylvania	255
potatoes	272
strawberries	292
Explorations by the Botanist	93
Exports, agricultural	54

F.

Facts concerning Oregon	584
Farm animals, number and prices of	46
Farmers' Club, American Institute	416
Farm experiments, recent	267
gates and fences, improvements in	332
Farming for boys	494
Farm management	433
managers, education of	523
products, prices of	36, 51
stock and fences, laws relating to	394
number and condition of	37
Fat steers	436
Faust	190
Fawkes's steam plow	306, 310
Feeding stock, experiments in	281
Fences and farm stock, laws relating to	394
gates, improvements in	332
hedges	172
Ferdinand	196
Fertilizers, analyses of	428
combinations for the purchase of	430
commercial, compared	285
experiments with	285, 291
laws concerning	429
compared	267
disproportionate prices of	428
home-made	431
on corn	269
mineral of the Mississippi Valley	548
natural	74
Fibrous plants	266
Finances of the Department	19
Fish culture	424, 451
in Maine	520
South Carolina	530
Fisheries of Maine	520
Oregon	600
Flax and hemp	57
Florida, crops of	27
Foot rot, remedy for	438
Forage plants and grasses, relative growth of	87
Foreign societies, exchanges with	256

Page.
Forest leaves and peat, manurial value 431
tree culture in Colorado 548
Iowa 541, 543
Missouri 546
Forests, destruction of, change of climate 516
French wine 633
Fruit and vegetables shipped from Norfolk, Virginia 447
crop of Massachusetts 521
culture in Iowa 543
Michigan 536
Missouri 545
growing in Western Illinois 444
in Eastern New Jersey 444
Northwestern Missouri 444
lands of Western Michigan 442
new method of preserving 534
products of Indiana 541
profit of choice and common 446
safes 444
shipments from California 445
Western Michigan 443
of Southern Illinois 443
small, business, growth of 445
in Eastern Pennsylvania 445
trees, drainage for 446
new method of grafting 446

G.

Gapes in poultry 423
Garden, experimental 17
vegetables, shipping 447
Gardening and civilization 159
landscape 159
Gardens and grounds, report of superintendent of 79
Gates and fences, improvements in 332
Geological collection 77
Georgia, crops of 27
Gilpin 193
Gladney's Red 188
Glover, Townend, Entomologist, report of 60
Golden Russet 186
Wilding 191
Grafting fruit trees, new method of 446
Grain bins, improvements in 329
&c., prize for system of drying 441
standing, protection of 442
Grape culture in Missouri 545
Wisconsin 539
Grapes, at Ohio State fair 533
classification of 81
trellis, covered 80
vines from leaves 416
Grass and hay, experiments with 273
Grasshoppers in Iowa 541
Grass lands in Connecticut 525
renovation of depreciated 280
Grasses and forage plants, relative growth of 87
cultivated, in Iowa 543
Green Cheese 197
Green-house as a winter garden 489
Grouping trees and shrubs and planting in masses 180
Grubs, experiment in destroying 296
Guano, analyses of 74
effects of 292
Peruvian, depreciation in 429
the Dr. Valentine 431
Guilford Red 197
Cully 198

H.

Hall 187
Hall's steam plow 310
Hand-book of the Sulphur Cure 512
Hand planters, improvements in 324
Harrows, improvements in 321
Harvesters, improvements in 326
Hay, American, inferior condition of 442
and grain, immediate curing of 441
grass, experiments with 273
crop of 1869 ..... 35, 22, 24, 31
curing in wet weather 281
early cut, for cows 285
ground 425
making, by machinery 441
rakes and forks 327

	Page.
Hay tedders and makers, improvements in	327
tedder, utility of	426
Hedges and fences	171
cost of	436
Helping Hand for Town and Country	510
Hemp and flax	57
Sisal, or Jenequin	257
Hemphill	196
Hempstead Plains	427
Hog cholera	43
a cure for	425
Hogs, statistics of	48
Home farm, Escrick Park, experiments	274
Hops in Wisconsin	538
Horse apple	185
hay-forks, improvements in	327
rakes, improvements in	327
meat	629
Horses, diseases of	40
statistics of	47
How shall we Paint our Houses	505
How to calculate the temperature favorable or unfavorable to vegetables	110
How to make the Farm Pay	499
Hoyal's Greening	190
Hubbard's Sugar	186
Hunge	185

I.

Idaho Territory, agricultural capabilities of	611
Illinois, crops of	29
Industrial University	452
mineral fertilizers of	575
Illustrated Annual Register of Rural Affairs, &c	509
Immigration	58
into Maryland	527
Imports of wool and woolens	54
Indiana, crops of	29
mineral fertilizers of	570
State Board of Agriculture, report of	539
State fair	539
Indian corn, experiments with	267
Industrial College of Kentucky	455
education, progress of	452
Influence of the solar system upon vegetable life	105
Insects injurious to the cranberry	207
Internal electricity of vegetables	149
heat of vegetables	115
International exchanges	12
Iowa, crops of	30
mineral fertilizers of	578
State Agricultural College	453
State Agricultural Society, report of secretary of	541
Irrigation and agriculture in Utah	431
as a renovator of pasture lands	526
sewage, profits of	432

J.

Japan raspberry	79
Jenequin culture in the United States	266, 267
profits of	261
enemies of the	264
field, preparation of	262
nurseries	263
or Sisal hemp	257
planting	262
rasping of the	265
varieties of the	258
Yucatan exports of, to the United States	265
Julian	184

K.

Kansas, crops of	30
State Agricultural College	454
Kentucky, crops of	29
Industrial College	455
mineral fertilizers of	564
Knapp's steam plow	317

L.

Lakes	174
Land rollers, improvements in	325
Lands, exhausted, renovating	426
non-productive, holding	10

	Page.
Landscape gardening	159
styles of	160
the geometrical style	161
natural style	161
Large Summer Queen	184
Lawns, formation and management of	168
Laws relating to fences and farm stock	394
Library	13
Limber Twig	189
Lime and salt	430
Limestones	548
Locust tree culture	420
Louisiana, crops of	28
mineral fertilizers of	556
Lucerne for soiling	526
Lumbering resources of Oregon	598
Lumber product of Wisconsin	539

M.

Madison County cattle sales	371
Maine, crops of	24
State Board of Agriculture, report of the secretary of	516
College of Agriculture and Mechanic Arts	459
fair	519
Manufacturing interests of Oregon	597
Manure and pork, making	283
from bones	634
sea-weeds	73
Manures, adulteration of	77
application of, in onion culture	219
chemical and barn-yard, compared	292
for the onion	217
mineral, English experiments with	273
vs. commercial fertilizers	520
Manurial value of forest leaves and peat	431
Maple sirup	420
Market abuses and their remedies	448
gardening	447
value of an established name	449
Marls	548
analyses of	72
Maryland Agricultural College	460
crops of	26
immigration into	527
Massachusetts Agricultural College	460
crops of	25
Institute of Technology	478
buildings of	485
course of instruction in	481
museum of arts of	479
school of	480
the society of arts of	478
State Board of Agriculture, report of the secretary of	521
Matimuskeet	192
Meat, preservation of	451
production of, in Europe	51
Menagerie farm, Escrick, experiments	276
Mental culture among farmers	6
Mercer potato	418
Merino, American	378
Meteorology, agricultural, report on	97
of 1869	638
Michigan Agricultural College	461
experiments	279
butter	362
crops of	30
mineral fertilizers of	572
State Agricultural College	535
Society	535
Board of Agriculture, report of the secretary of	535
Middle-men, complaint of	427
Milch cows, statistics of	48
Milk at Mobile	440
coolers, improvements in	333
producers, association of	449
Mineral fertilizers of the Mississippi Valley	548
products of Colorado	547
Wisconsin	539
Mineral manures, English experiments with	273
resources of Oregon	596
Mink business	424
Minnesota	30
College of Agriculture and Mechanic Arts	462
mineral fertilizers of	582
Mississippi, crops of	27
mineral fertilizers of	552

Page.

Mississippi, tea culture in ... 236
Missouri Agricultural College ... 461
crops of ... 29
mineral fertilizers of ... 560
State Board of Agriculture, report of the secretary of ... 544
Montana Territory, agricultural resources of ... 609
Mowing with a hoe ... 451
Muck on sandy loam ... 292
Mules, statistics of ... 47
Museum ... 14
agricultural, in Iowa ... 544
of the Department ... 60
donations to ... 636
Mutton sheep ... 381

N.

Natural fertilizer ... 74
herbarium, benefits to be derived from ... 95
Nebraska, crops of ... 31
New Hampshire Agricultural College ... 462
crops of ... 24
farm ... 434
New Jersey, cranberry culture in ... 209
crops of ... 25
Industrial College ... 463
New Mexico, agricultural capabilities of ... 619
New York, crops of ... 25
factory butter ... 360
live stock market ... 49
Nevada, crops of ... 31
Nickajack ... 193
Nocturnal increase of temperature, &c ... 125
Non-productive lands, holding ... 10
North Carolina, crops of ... 26
tea culture in ... 237
Northcott's steam plow ... 316
Notes from recent French publications ... 626

O.

Oats and barley, experiments with ... 255
crop of 1869 ... 24, 33, 35
Excelsior, tests of ... 252
experiments with, in Iowa ... 543
White Brunswick, tests of ... 254
Schönen, tests of ... 254
Somerset, tests of ... 254
Ohio Agricultural and Mechanical College ... 467
crops of ... 29
mineral fertilizers of ... 568
products, 1867–'68 ... 532
State Board of Agriculture, report of secretary of ... 531
fair ... 531
Onion, article on the ... 213
bending down the tops of the ... 214
culture, recent facts in ... 228
the fungus or smut in ... 229
yield and profits of ... 228, 229
diseases of the ... 224
remedies for ... 224
fly ... 224
remedies for the ... 226
harvesting and storing the ... 220
hoeing the ... 220
inorganic elements of the ... 216
manures for the ... 217
organic elements of the ... 216
potato ... 222
raising seeds of the ... 215, 219
resetting and maturing ... 221
seeds, what should be sown ... 215
sets, growing ... 221
soil for the ... 215
the top ... 223
varieties of the ... 213
Opium poppy, the culture of, in Smyrna ... 233
Orange and lemon trees in Italy, decay of ... 635
Orchard grass and blue grass in Missouri ... 545
for grazing and haying ... 523
Oregon, climate of ... 587
crops of ... 31
emigrant routes to ... 601
facts concerning ... 584
fisheries ... 600
government lands in ... 595

Page.
Oregon, healthfulness of the climate of ... 589
lumbering resources of ... 598
manufacturing interests of ... 597
market facilities of ... 593
mineral resources of ... 596
prices of farming lands in ... 594
schools ... 600
soil and products of ... 585
stock raising in ... 596
subdivisions of ... 590
Osage orange in Delaware ... 436
Outbuildings, stables, &c., arrangement of ... 165
Oxen and other cattle, statistics of ... 47
Oyster product of Maryland ... 528

P.

Palm fronds, the fiber of ... 266
Parry, C. C., Botanist, report of ... 91
Parsons on the Rose ... 508
Pasturage necessary to preserve the fertility of the soil ... 526
Pasture, permanent, experiments on ... 276
Pasturing and soiling ... 283
Patents, agricultural, of the year ... 315
Paying for the Farm ... 450
Paynes's Winter ... 189
Peach crop of Ohio ... 534
Culture for Profit ... 487
remarks on ... 198
the blight in ... 204
orchards, culture of ... 201
distance apart for trees ... 204
influence of stocks on growth and quality of fruit ... 203
mulching ... 200
planting ... 200
sites and shelter of ... 198
soil for ... 199
product of Indiana ... 541
tree, pruning the ... 201
Peat and forest leaves, mineral value of ... 431
Peddling strawberries ... 416
Pennsylvania Agricultural College ... 468
experiments with seeds at ... 252, 255
crops of ... 26
Peruvian guano, depreciation in ... 429
Philadelphia butter ... 360, 420
Phosphates of South Carolina ... 529
Pie plant poisoning swine ... 418
Pisciculture ... 424, 451
in Maine ... 520
South Carolina ... 530
Plan of improvements ... 164
Planters, hand ... 324
Planting near buildings ... 178
roads and avenues ... 177
Plaster and salt on clover ... 281
Pleuro-pneumonia ... 38
cure of ... 438
Plowing deep, experiments in ... 295
Plows, improvements in ... 316, 319
Plow, steam, the American ... 305
Plum, the wild goose ... 446
Poëy, Professor André, report of, on agricultural meteorology ... 97
Polish wheat, tests of the ... 250
Pork and manure, making ... 283
packing in the West ... 51
Potato beetle in Iowa ... 541
crop of 1869 ... 24, 34, 35
premium, Queens County, New York ... 448
diggers, improvements in ... 325
onion ... 222
the Mercer ... 418
Potatoes, amount of seed ... 272
change of seed of ... 293
experiments with ... 272
growing, by mulching ... 273
in Maine ... 519
Massachusetts ... 524
Wisconsin ... 537
making a home-market for ... 283
prices of ... 449
subsoiling for ... 273
sweet, care of ... 419
in bulk ... 451
Ohio ... 533

	Page.
Potatoes, thinning the stocks of	273
Poultry, gapes in	423
profits from	422
vermin upon	424
Prices of farm products	36, 51
Probstier barley, tests of	255, 256
Progress of beet-sugar manufacture in Europe	334
industrial education	452
Pruning the pear tree	201
Public parks	501

Q

Quinces, profits from	444

R

Rakes and forks, horse	327
Ramie	11
Raspberry from Japan	79
Rations according to the weight of animals	627
Rawles's Janet	189
Recent farm experiments	267
progress in steam culture	296
Reclaiming waste land	449
worn-out lands in Massachusetts	525
Red June	185
Remarks on pear culture	198
Report of the Botanist	91
Chemist	65
Commissioner of Agriculture	5
Editor	157
Entomologist	60
Statistician	20
Superintendent of Gardens and Grounds	79
on agricultural meteorology	97
Resources of the Southern Fields and Forests, &c	490
Rhode Island, crops of	25
Roads and avenues, planting	177
walks, construction of	166
laying out	165
Rockeries	173
Rollers, land	325
Root culture, importance of	421
food, concentrated	284
Rothampsted, (England,) experiments at	291
Rough Chaff wheat, tests of the	250
Rural affairs	499
Rust in wheat, prevention of	294
Rutgers's Scientific School, New Jersey	463
Rye crop of 1869	24, 32, 35
culture in Iowa	543

S.

St. Louis live stock market	50
Salt and lime	436
plaster on clover	281
as a manure for the beet root	331
mines in Louisiana	450
Saunders, William, Superintendent of Garden and Grounds, report of	79
Saxonian barley, tests of	255, 256
Scab, sheep	386
remedies for	387
Schools of Oregon	600
Sea-weeds as a source of manure	73
Seed distribution, advantages of	244
planters, improvements in	322
potatoes, change of	293
sow clean	425
spare the	425
Seeding of grain, variation in	293
thick and thin, of grain	293
Seeds, distribution of	17, 243
vitality of	294
Sewage at Aldershot, England	432
irrigation, profits from	432
laying out lands for the reception of	433
Sharpe's Greening	195
Sheep and cows, relative profits of	518
diseases of	42
experience in feeding	385
husbandry, facts in	378
husbandry in Iowa	542
Missouri	545
Wisconsin	538
mutton, breeds of	381
scab	386

	Page.
Sheep, statistics of	48
Sheffield Scientific School, Connecticut	452
Shockley	191
Shorthorns, sales of, in England	438
Silk culture in France	632
Italy	633
Sisal hemp, or Jenequin	257
varieties of	258
Smyrna, culture of the opium poppy in	233
Soiling and pasturing	283
Soils, analysis of	71
Sorghum in Wisconsin	537
sirup and sugar in South Carolina	530
South Carolina Agricultural and Mechanical Society, report of	529
crops of	27
experiments with clover and orchard grass in	280
phosphates	529
tea culture in	236
Southern agriculture	8
California, growth of	450
Sowing machines, improvements in	322
Spanish fever	39
Sparrows and currant bushes	418
Specialties in farming	520
Splenic fever	39
Standish's steam cultivator and triturator	310
State geologist for South Carolina	531
reports on agriculture	516
Statistician, report of	20
Statistics of beet-root culture	338
agricultural exports	54
cheese and butter factories in the United States	355
manufactories	353
shipments	353, 356
crops of 1869	20
fruit exports from Western Michigan	443
immigration	58
land values	10
live stock	47, 49
Madison County cattle sales	375
Ohio products	532
price of farm products	36, 51
sheep husbandry	379
Steam cultivator or triturator, Standish's	310
culture, comparative advantages of	302
comparison of rival systems	301
cost of tackle for	298, 303
different kinds of tackle for	298
expense of	303
implements for	301
increase of yield by	305
recent progress in	296
Steaming food	439
cheaply	438
Steam plow, Burridge's	309, 312
E. C. Bellinger's	306
Fawkes's	306, 310
Hall's	310
the American	305
Waters's	308, 311
plows patented in 1869	316
Steers, fat	436
Stevens's steam plow	316
Stewart's steam plow	316
Stock, diseases of	13
experiments in feeding	281
farm, diseases of	38
farm, number and condition of	37
improved, in Iowa	542
laws of the United States	400
live, markets	49
raising in Colorado	547
Oregon	596
vs. dairying	437
thoroughbred, in Wisconsin	538
Strawberries	80
experiments with	292
late *vs.* early	446
peddling	416
Strawberry plants, eighty enough	417
product of a single plant	416
Straw cutters, improvements in	331
Subsoiling, experiments in	287
for potatoes	273
Sugar-beet manufacture in Europe	334
production in the United States	349
cane, production	56

Page.
Sugar factory, German ... 348
maple, a plea for the ... 420
percentage of, in the beet ... 348
plantations in Louisiana ... 435
Sumac, American ... 230
analyses of ... 65, 230
consumption of, in the United States ... 231
culture ... 232
importations of ... 231
mill ... 232
preparing for market ... 421
relative quality of ... 231
Summer Cheese ... 185
Sweet corn, canning ... 451
potato, dried, analyses of ... 75
meal, analyses of ... 75
potatoes, care of ... 419
in bulk ... 451
Swine, cooked food for ... 281
diseases of ... 43
experiments in feeding ... 282
improved, in Iowa ... 542
Missouri ... 546
in France and Great Britain ... 629
poisoned by pie-plant ... 418
Superintendent of Gardens and Grounds, report of ... 79
Superphosphate, effects of, on corn ... 268
profit from ... 269

T.

Talavera wheat, tests of the ... 250
Tappahannock wheat, tests of the ... 245
Taveau's steam plow ... 317
Tea culture in California ... 236
Mississippi ... 236
North Carolina ... 237
South Carolina ... 235
the United States ... 235
preparation of soil and sowing seed ... 238
site, soil, and climate for ... 237
factory, buildings for ... 238
green and black, difference between ... 235
imports of, into the United States ... 235
leaves, plucking ... 240
manufacture of ... 241
plantation, preparation for ... 237
the laying out of ... 238
plant nurseries, forming of the ... 239
plants, mode of planting seedlings ... 239
pruning ... 240
transplanting ... 239
the culture and preparation of, in India ... 237
Temperature of cow stables ... 295
Tennessee, crops of ... 28
mineral fertilizers of ... 562
Territories, agricultural capabilities of the ... 601
crops of ... 31
Tests of Department seeds ... 242
Texas cattle in Michigan, laws regulating ... 537
plague ... 540
crops of ... 28
The cranberry interest ... 204
Thrashing and winnowing machines, improvements in ... 328
Timber in Iowa ... 541
Tobacco crop of 1869 ... 24, 34, 35
worms, experiments in destroying ... 296
Top onion ... 223
Townley and Freidrich's steam plow ... 317
Tree culture in the West ... 94
Trees suitable for small grounds ... 172
Trellis, grape, covered ... 80
Trichina spiralis ... 389
preventive of ... 393
treatment of ... 393
Tricks of trade ... 427
Truck farming in New Jersey ... 447
Tubney, Warren, Abingdon, experiments ... 275
Tyrwarnhaite farm experiments ... 278

U.

Underdrain, an inexpensive ... 426
Utah, irrigation and agriculture in ... 431
Territory, agricultural capabilities of ... 617

Page.

V.

Vermin upon fowls 424
Vermont butter........ 361
crops of........ 25
Vineland as a lesson in colonization 410
plan, copying the........ 415
principles of settlement of........ 412
results of the experiment of........ 414
social feature of........ 415
the soil of........ 411
value of the example of 415
Vineyards at Syracuse, New York, and near Wilmington, North Carolina........ 447
Vineyard, the largest, in the world........ 447
Virginia, crops of........ 26
Voelcker, Professor, experiments of........ 273

W.

Walker's Yellow........ 187
Washington Territory, agricultural resources of........ 613
Water—lakes 174
Watermelons, large 419
Waters's steam plow........ 308, 311
Weeds of Maine........ 503
Western butter 363
Michigan, fruit lands of........ 442
West Virginia, crops of 28
University 466
Wheat, Arnautka, tests of the 249
crop of 1868 in Maine........ 518
1869 .... 21, 24, 32, 35
Iowa 542
culture........ 9
in Indiana........ 540
Wisconsin........ 537
experiments with varieties of, at Agricultural College of Pennsylvania 252
in California........ 251
on corn ground........ 442
premiums for 532
prevention of rust in 294
Rough Chaff, Talavera, and Polish 250
the Tappahannock, tests of........ 245
Whey butter........ 367
White Brunswick oats, tests of........ 254
Schönen oats, tests of 254
Somerset oats, tests of 254
Winter Pearmain 188
Wild Goose plum 446
Wilkins's steam plow 316
Wine, aging 68
changes in 66
French........ 633
making at Syracuse, New York........ 447
in Missouri 545
Sap 193
Wines analyzed in Department laboratory........ 66
Winne's, Jurian, experience in feeding sheep........ 385
Winter butter........ 366
Horse 195
Wire worms, protection against........ 442
Wisconsin Agricultural College........ 469
Society, report of the secretary........ 537
crops of 30
mineral fertilizers of 580
Wool industry 7
Wools and woolens, imports of 54
Worms, damage done by 632

Y.

Yak, acclimation of the........ 433